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# REVIEWS

### Griggs's Botanical Survey of the "Sugar Grove Region," Ohio *

This paper is a good description of an area which is seldom mentioned in phytogeographical literature, though of exceptional interest and located in one of our most thickly settled states. An 11-page introduction treats of the geology, topography, soils and climate, and there are 37 pages on the vegetation ("ecology"), 6 on economic aspects, and 36 on the flora. The illustrations are excellent half-tones of scenery, vegetation, or single species of plants, most of them apparently never published before; but they are not dated, so that the reader can only guess at what season they were taken from the appearance of the foliage or flowers.

The area has no very definite boundaries, but is located in Fairfield and Hocking counties, a little southeast of the center of Ohio, in the unglaciated Carboniferous plateau region that extends from Pennsylvania to Alabama. (Some of the illustrations could be matched pretty closely in the coal region of Alabama.) The topography is very broken, though hardly mountainous. (Many readers will doubtless be surprised, as the reviewer was, to learn that there is such rugged topography in Ohio, for much of the surface of that state is very flat.) The soils are mostly derived from sandstone, and therefore deficient in basic materials. The nature of the soil and topography has retarded agricultural development, and thus allowed this area to remain one of the best "botanizing grounds" in the state.

The average growing season is 155 days, the average annual snowfall 25 inches, and the rainfall (from 35 to 40 inches a year) is pretty evenly distributed through the seasons, but with a slight excess in the summer months. In this last particular this locality resembles many other places with somewhat sandy soils,† and differs from most places in the Ohio valley.

* A botanical survey of the Sugar Grove region. By Robert F. Griggs. Ohio Biol. Surv. Bull. 3, or Ohio State Univ. Bull. vol. XVIII (18), no. 25, or Contr. Bot. Lab. O. S. U. no. 84. 98 pp., frontispiece, 29 numbered text-figures, and full-page map. "April" 1914 [or rather August, according to a letter from the author]. (The pages are numbered from about 247 to 340, but an examination of Bulletins 1 and 2 of the same series leaves one in some doubt as to the title of the volume to which the pagination belongs.)

† See Geol. Surv. Ala. Monog. 8: 24 (footnote). 1913.

The descriptions of vegetation cannot be adequately summarized in a brief review, but must be seen to be appreciated. For each of the habitats, about fifteen in number, the environmental factors are described in a general way, and the commoner plants listed (usually about one third of the vascular species and sometimes a few mosses and lichens), usually in approximate order of abundance or conspicuousness, but often disconnectedly, and with a somewhat arbitrary distinction between dominant and secondary species. At the beginning of most of the habitat lists the names of one or two species regarded as dominant are printed in small capitals; the rest being in italics. (The method of treatment is not very well explained in the paper itself, but some of the facts given in this paragraph have been obtained subsequently by correspondence with the author.)

Some valuable original suggestions are made about the critical environmental factors for certain species, but some of these do not seem to hold throughout the ranges of the species. For example, on pages 270 and 283 it is stated that *Betula lenta* requires a constant supply of water near the surface. But in Massachusetts, New York and Michigan it grows in ordinary "mesophytic" upland woods, and at its southern limits in the mountains of Georgia and Alabama it is chiefly confined to exposed cliffs at high elevations (often with *Kalmia latifolia*). On page 283 *Kalmia latifolia* is said to be "preëminently a sun-loving plant"; but it grows in dense shade always in Florida, often in North Carolina, and sometimes in Massachusetts. (For both of these species protection from fire is probably a more important factor than soil moisture or insolation.)

Very interesting is the suggestion on pages 283–286 and 290–292 that evergreen herbs are confined to places where they are not crowded by other plants or liable to be smothered by falling leaves. It has seemed to the reviewer, however, that such herbs are especially characteristic of soils poor in potassium and pretty well protected from fire* (this is especially manifest in the case of epiphytes, all of which seem to be evergreen†); but at the same

* See Bull. Torrey Club 38: 517. 1911; 41: 214–217. 1914.

† See Ann. N. Y. Acad. Sci. 17: 38. 1906.

time the volume of annual leaf-fall is likely to be least in the poorest soils, *ceteris paribus*,* so that the dead-leaf hypothesis is not disproved. (And epiphytes are naturally just as exempt from smothering by leaves as they are from fire and overfeeding.)

The flora is pretty rich: 972 species of vascular plants being listed. This includes quite a number which have not been seen there by botanists now living, but the mosses and lichens mentioned in the ecological part are not enumerated in the taxonomic part. Most of the species in the catalogue are not referred to any habitat, which seems an unfortunate omission in a work which is so largely ecological. On the other hand, a few of the vascular plants mentioned in the descriptions of vegetation (just how many it is difficult to determine without an index) are not mentioned in the catalogue; but such omissions may be wholly the fault of the printers.

Nearly all the species in the catalogues are given "common" names, fictitious ones being used where no bona-fide ones have been discovered. Most but not quite all of the specific names are decapitalized. Over 15 per cent. of the technical names, and a few other words, are misspelled, many of them more than once or with more than one letter wrong.

From the summary at the end of the catalogue it appears that 22.7 per cent. of the angiosperms are monocotyledons: a figure agreeing pretty well with those for other unglaciated parts of the Paleozoic region of eastern North America.†

One of the objects of a review is to point out the good and bad features for the benefit of those who may undertake similar work afterwards (and there ought to be many more papers of this sort for other parts of the world). Among the good features of the work under consideration are the satisfactory descriptions of physical features, especially climate, the excellent illustrations, the careful classification of habitats, the amount of space devoted to environmental factors, the arrangement of species in order of abundance in the habitat lists, and the accurate identifications of species (a matter with which the Ohio botanists seem to be more

* See Bull. Torrey Club 40: 399. 1913.

† See Torreya 5: 207–210. 1905.

particular than some others are). Most of the shortcomings are not peculiar to this paper by any means, but are merely manifestations of widespread modern tendencies, due largely to excessive specialization in education and a growing indifference to matters not directly in one's line; and for some of them the author can hardly be held responsible at all. Others are points which will probably be given more attention in the future than they have in the past. The principal ones are:

Using too many different serial numbers on cover or title-page, one of them Roman (a sort of notation which has outlived its usefulness).

Dating the publication falsely, and thus working an injustice to any one who may have published something similar between the alleged date and the real date.

Omitting dates from illustrations (where they are just as useful as on herbarium labels, etc.).

Carelessness in spelling and proof-reading.

Using the terms "region" and "ecology" too loosely.

Too few comparisons with other parts of the world and citations of previous literature.

Insufficient explanation of the methods of treatment.

Too little correlation of vegetation with soil.

Lack of quantitative figures for vegetation.

Assuming that species treated as native in floras of the northeastern United States must be indigenous in every part thereof, even where the habitat indicates otherwise.

Too great discrepancy between ecological and taxonomic parts, in number of species included.

Using fictitious common names, which appear to serve no useful purpose, and take up space which might be better occupied with information about habitats or other significant facts.

Decapitalizing specific names, and thus obliterating certain interesting etymological distinctions without benefiting the reader appreciably.

ROLAND M. HARPER

# OHIO BIOLOGICAL SURVEY

HERBERT OSBORN, Director

Volume I

Bulletins I to IV

1913 - 1915

Published by
THE OHIO STATE UNIVERSITY
Columbus

# Table of Contents

## VOLUME I

THE OHIO STATE UNIVERSITY BULLETIN
VOLUME XVII NUMBER 31

# OHIO BIOLOGICAL SURVEY

BULLETIN 1

## ANNOUNCEMENT

## SYRPHIDAE OF OHIO

June, 1913

PUBLISHED BY THE UNIVERSITY AT COLUMBUS
Entered as second-class matter November 17, 1905, at the postoffice at Columbus, Ohio, under Act of Congress, July 16, 1894.

# OHIO BIOLOGICAL SURVEY

HERBERT OSBORN, Director

## OHIO STATE UNIVERSITY IN CO-OPERATION WITH OTHER OHIO COLLEGES AND UNIVERSITIES

Administrative Board consisting of Representatives from co-operating institutions.

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## ANNOUNCEMENT

The Bulletins of the Ohio Biological Survey will be issued as work on any special subject is completed, and will form volumes of about 500 pages each.

They will be sent to co-operating institutions and individuals, libraries and colleges in Ohio and to such surveys, societies and other organizations as may offer suitable exchange material.

Additional copies of each bulletin and of completed volumes will be sold at such price as may cover cost of publication. Special rates on quantities to schools for classes.

Subscription for entire volumes, - $2.00
Price of this number, - - - - - .50

All orders should be accompanied by remittance which should be made payable to *Ohio Biological Survey* and sent to the Director.

Correspondence concerning the Survey, applications for exchanges and purchase of copies of Bulletins should be addressed to the Director—Professor Herbert Osborn, Columbus, Ohio.

Volume 1 Bulletin 1

# Ohio Biological Survey

## OUTLINE OF BIOLOGICAL SURVEY PLAN

## THE SYRPHIDAE OF OHIO

BY

C. L. Metcalf

Published by
THE OHIO STATE UNIVERSITY
Columbus,
1913

# INTRODUCTION

In this initial bulletin of the Biological Survey of Ohio, it may be desirable to state in brief the plan of organization and purposes of the Survey, both for the sake of the record as to its inauguration and as an indication of the problems which it will attempt to solve, and the services it is designed to render to the state.

The Survey is inaugurated as the result of a plan of co-operation between a number of the different Colleges of the State; its origin being in the Ohio Academy of Science. As a result of various discussions as to the ways and means to provide for such a Survey, a committee, a year ago, was appointed from members of the Ohio Academy of Sciences, and this committee presented the following provisional plan, which was submitted to the institutions forming the Ohio College Association.

## PROVISIONAL OUTLINE

The following preliminary outline for a Biological Survey is based upon suggested co-operation between the various educational and other institutions in the state interested in securing definite knowledge concerning the fauna and flora of Ohio.

The object of the Survey will be to secure accurate and detailed information as to the occurrence, distribution, and ecology of the animals, and plants in Ohio for the benefit of the people in general and particularly for those engaged in school instruction, and to collect, identify, and distribute material that may be of service in educational work.

The co-operation proposes either financial or scientific support, or both, from institutions, organizations, or individuals, interested in the purpose of the survey.

The central office and general management will be arranged in connection with the State University and under the official control of its trustees. The co-operative board is planned to consist of a representative from each institution and organization agreeing to the plan of co-operation and contributing a membership fee of $25, such representative to be appointed by the executive officer in the institution or organization. The functions of the co-operative board will be to outline the policy of the Survey, recommend the distribution of the work by localities and among specialists, to nominate the director, and determine on such other recommendations as may seem to them desirable for the success of the Survey.

The Director of the Survey shall be appointed by the board of trustees after nomination by the co-operative board, and his duties shall be to have general executive management of the Survey, the details of co-operation with individuals, the direction of special assistants, and the arrangement of papers for the board of publication. He shall also act as Secretary of the co-operative board, and approve all bills paid from the Survey fund.

The publications shall consist of a series of bulletins, each to be issued as promptly as possible after the completion of any piece of work.

A series of memoirs or monographs to include the more extended results of special investigations will be undertaken if the material together with the support necessary for such publication becomes available.

The contributions from the co-operating institutions and from individuals and any specific appropriations from the state shall constitute a fund for biological survey purposes, to be drawn upon by order of the director.

From duplicate material secured in progress of the work, special collections may be arranged and forwarded to such schools as may wish them under regulations to be determined by the co-operative board. Meetings of the co-operative board shall be on the call of the Director. There shall be at least one meeting each year, ordinarily in connection with the meeting of the Ohio Academy of Science, for the purpose of hearing reports and outlining the work of the ensuing year.

*Committee:* L. B. WALTON, Gambier O.
E. L. RICE, Delaware, O.
February 1, 1912. FRANK CARNEY, Granville, O.

In response to this outline definite acceptances were obtained from the following institutions:

Miami University
German Wallace College
Ohio Wesleyan University
Wittenberg College
Buchtel College
Western Reserve University
Oberlin University
Kenyon College
Baldwin University
Denison University
Lake Erie College

Favorable responses were received also from Ohio University, Otterbein, and Heidelberg University, and later acceptance from the University of Cincinnati.

A request presented from the Committee in accordance with these provisions to the Trustees of the Ohio State University was granted and the plan approved at the meeting of the Board, June 1912. Subsequently by nomination from the different representatives of the co-operative institutions, Prof. Herbert Osborn was elected as director and later at a meeting the representatives of the various institutions, Nov. 30, it was agreed that the then representatives should be known as the Administra-

tive Board of the Biological Survey and the provisional plan definitely adopted as permanent.

The General Assembly at its 1913 session appropriated for the University Budget of 1914 the sum of $2,500.00 for Biological Survey purposes and this support will make possible the undertaking of some of the more urgent problems demanding early attention.

In addition to the plans indicated in the provisional outline it may be proper to say that the scope of the Survey is expected to be similar to that of various states which have such Surveys in progress. In its plan, however, it differs somewhat from any of those in that it involves a method of co-operation among the educational institutions of the state.

Work of similar character carried on in Illinois, Indiana, Michigan, Pennsylvania, New York, New Jersey, and Connecticut and other states will be considered in maturing the plans of the Survey. It is expected, however, that many of the details will be developed as time goes on in reference to particular problems that may present themselves in Ohio or in such manner as to correlate the work with other state organizations.

It is evident that one of the first subjects for attention, concerns collection of data from different sections of the state so as to determine what existing species of plants and animals occur in the state, or in other words to secure a state census of the different species of plants and animals.

Such study is especially desirable for the purposes of accurate instruction in the various schools; to form the basis of ecologic and faunistic studies and furnish information for those who are interested in knowing the details of our state fauna and flora.

From the plan of its organization it is evident that the Survey attempted will serve primarily the educational institutions, and for these it is proposed to publish as promptly as possible, catalogs and keys of the various groups of plants and animals, as well as to prepare helps for their indentification. These will be made as far as possible, sufficiently non-technical to be used by students in the lower grades of school work as well as the colleges. Furthermore, it is planned to prepare from duplicate material collected in the survey, representative collections which may be sold or loaned to schools throughout the state, as the means of arranging and assisting in the study of the state Biology.

Another feature which will require attention is the ecologic study of different localities of the state, especially to determine the association of various Biological factors that depend upon topographic and physical conditions or some special environment. This will include primarily the

study of representative districts, such as swampy areas, hilly country, and river valleys, and ultimately such study should cover practically every county of the state.

It will be seen that such studies as these must in time form a very important basis in the determination of the greatest utility for the particular sections which are studied and consequently give a foundation for important economic application. It will be the purpose of the Survey to co-operate with other state organizations such as the state experiment station in the determination of factors which will be of service in the agricultural development of the state and the utilization of forest areas; of the fish commission in the studies which will determine with the greatest accuracy the content and food supply for fish culture for the aquatic areas of the state, and with the State Board of Health for the determination of the distribution, occurrence and the importance of such species as may have relation to disease in water contamination or as carriers of diseases affecting man or domestic animals.

The survey is especially fortunate in having the co-operation of a number of men who are eminent in particular fields of Biological study and who, from their connection with the different educational institutions of the state, are in a position to render a most important service in this connection.

Some idea of the value of this service may be realized from the statement that the survey has the promise of assistance from such men as Mr. Charles Dury of Cincinnati, Dr. Sterki of New Philadelphia, Professors Williams and Fink of Miami University, Walton of Kenyon, Jones, Grover and Nichols of Oberlin, Stickney and Coghill of Denison, Brookover of Buchtel, Sullivan of Western Reserve, Fuller of Baldwin University, Schaffner, Hine and Griggs of the Ohio State University and others.

The bulletins which it is planned to issue to present the results of the investigations, will be published at irregular intervals as such investigations are completed, and will be distributed to the co-operating institutions and to other organizations with which they may be exchanged and will be put on sale at such price as may cover the cost of publication.

Announcement of such issues, will be made from time to time. Organizations desiring to secure these publications for exchange are invited to correspond with reference to such exchanges, stating the character of publications which may be offered in return. Or a regular subscription for entire volumes may be placed as announced on cover.

# THE SYRPHIDAE OF OHIO

## A Biologic, Economic, and Systematic Study of the Family in the State

BY

CLELL LEE METCALF, M. A.

Extracted from a Thesis Presented to the Faculty of the College of Arts, Philosophy and Science of the Ohio State University as the Thesis Requirements for the Degree of Master of Arts, Commencement, June, 1912.

# TABLE OF CONTENTS

## INTRODUCTION

The Syrphidae deserve to take high rank among the families of insects because of their varied interest to the student of nature. It is one of the largest and most beautiful of the families of Diptera and, so far as adults are concerned, one of the best known systematically. The larvae present some very peculiar forms and a remarkable diversity of habits. The family possesses some excellent examples of mimicry; perhaps no other family of insects so much resembles another order as the Syrphidae do Hymenoptera. And, finally, the economic importance of its species, both in the larval and adult stages, is, at the same time, very great and very little appreciated.

The economic status of the family as a whole is decidedly beneficial because of the aphidophagous habit of many of the larvae. There are no well known pests; although one, whose larva feeds on the pollen and cells of corn, has at times excited some alarm in certain localities; and the larvae of certain species in Europe are known to destroy the bulbs of such plants as Narcissus, Amaryllis and onion. None of the species has ever seriously or extensively intruded on the public welfare and consequently they are not well known to people generally. Their services while exceedingly valuable have not been of such a conspicuous nature as to change this condition.

Although it has been well known for many years that the Syrphidae are very beneficial because of the ravages of their larvae on plant lice, it appears that our knowledge of their immature stages is deplorably meagre. A small number of species has been more or less briefly described in one or more of their immature stages. Usually these are isolated descriptions of single species, which entomologists have happened upon while pursuing other lines of investigation. The various writers have, of course, had no common basis of description, and most, if not all of the descriptions are entirely inadequate for specific separation. In only one case did I find a figure of the larval mouth-parts; and I have been able to find no detailed description of the posterior respiratory apparatus in any paper. Again no one seems to have noticed the remarkably constant occurrence of a definite number (12) of spines or bristles (differentiated from any other vestiture which may be present) in transverse rows across the body of the larva.

Everyone recognizes that it is always desirable and often exceedingly important to be able to identify an insect in its immature stages; especially as a larva. This phase of Entomology has been too much neglected. It is true that none of the immature stages presents such a variety of characters as does the imago, and distinctive description is consequently much more difficult. Yet I believe it will be found possible, at least among the Syrphidae, to describe the larvae and pupae in such a way that they can be definitely recognized.

It was with two points in mind, therefore, that the life-history studies which were the basis of this paper, were carried on from 1909 to 1911. An attempt was made (1) to determine definitely what species are aphidophagous in Ohio, of how much importance they are, and something of their life-histories and biological relations; and (2) to make possible the specific identification of immature stages. Naturally the subject has by no means been exhausted. Such results as were achieved have been reported from time to time in a series of articles in *The Ohio Naturalist*.* In these articles nine species are carefully described in their immature stages; eight of them, so far as I am aware, for the first time. Brief synopses of these articles together with notes on one or two other species will be found on the following pages. A goodly number of Ohio species with the aphidophagous habit must still remain to be described.

ACKNOWLEDGEMENTS

I am happy to acknowledge here, briefly but none the less sincerely, my obligations to those who helped me in various ways in this work. First of all to the Professors of Entomology at the Ohio State University: Professor Herbert Osborn whose inspiring encouragement has been most helpful; Professor James S. Hine who has collected and studied the Syrphidae very carefully and who most generously supplied me with everything he had in the way of specimens and literature as well as with helpful advice and criticism. The list of species in Part III is based largely on specimens collected and originally identified by him and now embraced in the University collection of Diptera.

To my brother, Professor Z. P. Metcalf of West Raleigh, N. C., I am indebted for many helpful suggestions, for certain materials for study, and for a critical reading of the manuscript. Professor W. M. Wheeler of Harvard University supplied me with larvae and pupae of the genus

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" " " " Vol. XII, No. 1, pp. 397-404, 1pl. Nov., 1911
" " " " Vol. XII, No. 5, pp. 477-488, 1pl. Mar. 1912
" " " " Vol. XII, No. 8, pp. 533-541, 1pl. June, 1912
" " " " Vol. XIII, No. 5, pp. 81-93, 2pl. March, 1913

*Microdon.* Certain of my fellow students have directed me to materials for study and my wife has helped me in innumerable ways.

Of the literature on this family, the works of Dr. S. W. Williston have been most useful. His excellent *Synopsis of North American Syrphidae* is indispensable. I have made constant use of it. In Part III, the keys to species under each genus are adapted for the most part from this work; being restricted, however, to cover only those species which have been, or seem likely to be, taken in the State. The key to genera is taken almost *verbatim* from the same author's *Manual of North American Diptera.*

J. M. Aldrich, *Catalogue of North American Diptera*, lists in some sixty pages most of the important papers on this family which appeared previous to January 1, 1904. The student is referred to it for synonymy; and descriptions which do not appear in Williston's *Synopsis* will for the most part be cited there.

The work of Verrall on British Flies is very useful and I am indebted to it for many of the notes on metamorphoses and larval habits given in Part II. Other papers to which the Ohio student will most likely wish to refer are listed in a brief bibliography.

## Part I.

### HISTORICAL ACCOUNT OF THE FAMILY

The first of the genera of Syrphidae to be established was *Rhingia*, described by Scopoli from Europe in 1763. The following year Geoffroy described a species of *Volucella* from Paris. Eleven years later (1775) Fabricius founded the genus *Syrphus* and nineteen years after this the genus *Ceria*. Nothing more of importance was done until 1803 when Meigen described half a score of genera from Europe.

From 1804 to 1825, Latreille, Fabricius, Meigen, Fallen, Weidemann and St. Fargeau and Serville added several dozen genera; and the latter year Latreille described the first genus (*Sphecomyia*) from North America. From 1834 to 1875, Macquart, Loew, Rondani and Schiner from Europe, Walker from Brazil, and Philippi from South America were the principal students of the family. From 1876 to 1881, Osten Sacken added half a dozen North American genera, while since 1882 Williston from North America and Bigot have described a number of new genera and many species.

Our knowledge of the family in North America is due very largely to the efforts of Meigen, Wiedemann, Say, Macquart, Schiner, Loew, Osten Sacken, Bigot, Williston, W. A. Snow, W. D. Hunter, R. C. Osburn, C. H. T. Townsend, C. W. Johnson and D. W. Coquillett.

In Ohio, so far as I can determine, Professor James S. Hine has been the principal worker. An early state list of 25 species was published by him in the *Proceedings of the Ohio Academy of Science*, Vol. II, pp. 48-54, 1899. A later list of 92 species was read by him before the Ohio Academy of Science in 1902. Mr. Chas. Dury of Cincinnati has a State collection of 75 or 80 species among which are a few not listed from any other part of the State.

## SYSTEMATIC POSITION

The *Syrphidae* is one of the four families belonging to the *Cyclorrhapha* which have no frontal suture (Fig. A): the other three are the *Pipunculidae*, the *Platypezidae*, and the *Phoridae*.

The *Cyclorrhapa* is that group of Diptera in which the adults emerge from the puparium—which is a pupa-case made by the induration of the last, unmoulted, larval skin—by pushing off in front a *circular* disc-like operculum. In the contrasting group, the *Orthorrhapha*, the adult escapes from the pupa-case thru a *T-shaped* antero-dorsal orifice made by two splits, one lengthwise, the other transversely.

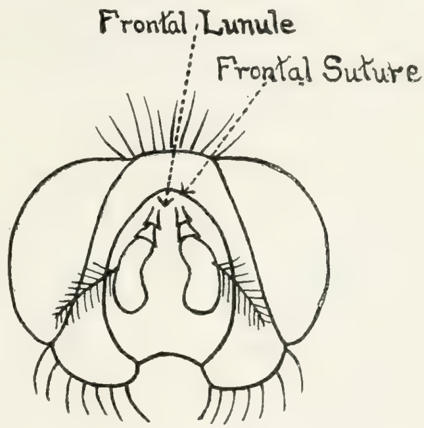


Fig. A. Head of a fly

In the great majority of the *Cyclorrhapha* the operculum is forced off by expansion of a bladder-like body, the *ptilinum*, which is protruded thru a suture above the antennae of the nymph, known as the frontal suture. In the four families mentioned above the frontal suture is absent; there is no ptilinum; and the operculum is pushed off, along a line of weakness, by expansion of the face below the antennae. This is probably responsible for the great amount of structural variation to be found in the face of the adult Syrphidae which is often of much use in classification.

The four families mentioned above are usually placed at the beginning of the Cyclorrhapha, and in some respects they are intermediate between this group, as a whole, and the Orthorrhapha.

Verrall locates the *Syrphidae* between the *Pipunculidae* on the one hand (with which, according to Girschner, they are connected thru

the genera *Nephrocerus* and *Baccha*) and the *Conopidae* on the other. The relation to the latter family is indicated in the porrect and elongate antennae of the genera from *Milesia* on, and especially of *Ceria* in which the antennae end in a terminal style.

## PHYLOGENY

In this paper the arrangement is that given in Aldrich's *Catalogue of North American Diptera*.

Williston is probably correct in stating that the characters of the immature stages should not be expected to furnish basis for a classification to supersede that founded on the more diverse and complex characters of the adults. Nevertheless it seems to me that a careful study of larval structures and habits in many genera should throw light on fundamental relationships, and might change the classification to some extent or, at the least, tend to confirm the position of some of the more doubtful genera. Especially does this seem promising in a group like the Syrphidae where there is such a dearth of good sub-family characters. For example, according to Williston, the genera *Paragus* and *Pipiza* are placed in the tribe *Chilosini*. These two genera are, in part at least, aphidophagous as larvae and are structurally like aphidophagous larvae. The other genera of this tribe, viz., *Chrysogaster*, *Chilosia*, *Chalcomyia*, and *Myiolepta* live as larvae in decaying matter or on plant tissue, and some of them at least (*Chalcomyia*) are rat-tailed. Now this would seem to indicate that the former genera naturally belong with the *Syrphini* where the larvae are predominantly aphidophagous.

It seems to me almost certain that a complete study of larval characteristics and habits, together with what is known about the imagoes, will make possible a satisfactory division of this large family into sub-families, which is conceded to be impossible from a consideration of the imagoes alone.

As will be shown below the family characteristics are simple and very definite. The species are also for the most part reasonably distinct. But the presence of many vexing, intermediate forms makes it almost impossible to break the family up into satisfactory sub-families or in some cases to group the species into genera.

Three large sub-families are rather definitely noted: (1) The *Syrphinae* or group with the anterior cross-vein of the wing before the middle of the discal cell, the femora rarely thickened; slender, thinly pilose, more delicate species. (2) The *Eristalinae* with the anterior cross-vein near or beyond the middle of the discal cell, femora frequently

thickened; larger, pilose species. (3) The *Cerinae*, a small group, differing from all the others in having a terminal style rather than a dorsal arista on the antennae.

Williston further divides these sub-families into fourteen tribes which, while they doubtless show many true relationships, are by no means always satisfactory.

Verrall in his work on British Flies makes seven sub-families; using besides the ones mentioned above, *Volucellinae*, *Milesinae*, *Chrysotoxinae* and *Microdontinae*.

## GEOGRAPHICAL DISTRIBUTION

In general both genera and species in this family are widely distributed. There are about 2,000 described species from all parts of the world. Of these over 300, belonging to about 60 genera, occur in America north of Mexico. Only about 5 or 6 genera are restricted to America; 42 are common to Europe and North America, and nearly 40 species are known to be common to these two continents. It is my belief that this latter number will be augmented considerably when examples from the two continents are more carefully studied. At any rate I can see no essential differences between the descriptions by Verrall of certain species from Great Britain, and the descriptions of others under different names from North America.

As is shown by so many other biological groups, the distribution of the species in this family indicates greater resemblance between the Pacific and European faunas than between the Atlantic and European.

Forty-one genera and about 113 species are listed in the present paper as actually collected in the State. Many of these species are wide spread, not only in the State but over large parts of the country. A number are found on other continents as *Paragus tibialis*, *P. bicolor*, *Platychirus peltatus*, *Melanostoma mellinum*, *Syrphus torvus*, *S. ribesii*, *S. grossulariae*, *Eristalis aeneus* and *Syritta; pipiens* and a few (notably *Eristalis tenax*) are cosmopolitan. Others are much restricted in the State; for example the species of *Microdon* have been taken in the State only near Cincinnati.

## GEOLOGICAL DISTRIBUTION

A number of fossil insects of this family have been worked out by Dr. S. H. Scudder from American Tertiary beds. These belong preponderantly to the Syrphinae, or the group with the basal cross-vein. The following genera are definitely recognized: *Syrphus* (abundant), *Chilosia*, *Chrysogaster*, *Rhingia*, *Sphegina* and probably *Pipiza*. In addition a fossil *Microdon* was found at Aix, and the following genera have been

found in amber: *Volucella*, *Criorhina*, *Eristalis*, *Helophilus*, *Merodon*, and *Milesia*.

## GENERAL CHARACTERS: THE EGG

The eggs of this family that I have seen (mostly of aphidophagous species) are all chalk-white in color, and hence conspicuous on the darker surface of the leaf or twig on which they are usually deposited. They are elongated-oval in outline, subcylindrical, truncated at the micropylar end, rounded at the opposite end; flattened slightly to the surface on which they are deposited, slightly humped above. The length is frequently a little less than one millimeter.

The entire exposed surface of the shell, except a small region around the dark micropyle, shows a delicate and very beautiful sculpturing, consisting, in aphidophagous species, of numerous microscopic elevations of the surface, arranged in lines obliquely around the egg. Each of these elevations has a main *body*, longer than wide, and radiating from this a greater or lesser number of delicate, arm-like projections extending into the spaces between adjoining *bodies*. The *arms* may branch slightly and may end freely, or meet similar processes from the same or other *bodies;* often making a rather complex network of slender white *arms* between the larger elevations. (Figs. 17, 43, 63, 143.)

### CHARACTERS AVAILABLE FOR CLASSIFICATION

I know of no naked-eye characters that are specific. However with further study we may be able to distinguish the eggs of many species microscopically. There is a considerable variation in size of the eggs, especially between the different genera. In addition to this the characters which are likely to prove useful are to some extent the shape of the egg; the size, shape, and number of the elevated, sculptured *bodies* on the shell; the number of *arms* radiating from them; the relative width of separation of the *bodies;* etc. These characters are difficult to see clearly, requiring high magnification and very favorable illumination.

The time of oviposition for the aphidophagous species may be said to be considerably correlated with that of the appearance of aphid colonies. The others are subject to the usual seasonal conditions. No definite dates can be given which are generally true except to say that oviposition for the first spring generation commonly takes place very soon after what we recognise as the Spring awakening of our fauna and flora.

The duration in the egg-stage was determined for two species (see under *Syrphus americanus* p. 55 and *Allograpta obliqua* p. 58 ) in which it ranged from 55 hours to 3.5 days (indoors.) The egg-stage of *Mesogramma polita* is said by Ashmead to be three or four days.

Aphidophagous species deposit their eggs on various parts of plants which are, or will generally be, infested with plant-lice. *Eristalis tenax* was found depositing eggs on or near the surface of very foul water. The former species deposit their eggs singly, gluing them flat to the surface especially by the posterior end; those of *Eristalis* sp. were found in masses, the eggs ranked side by side and nearly perpendicular. (Fig. 142.) Wheeler believes that adults of *Microdon* frequently oviposit in the same nest in which they mature. Verhoeff observed adults apparently trying to oviposit among the ants on the outside of the nests.

I have noted no methods of natural protection except the sheltered position in which they are sometimes placed; nor have I found any egg parasites.

## GENERAL CHARACTERS: THE LARVA

The larvae of *Syrphidae* which I have had an opportunity to examine represent four distinct larval habits, and, structurally, are of at least three quite different kinds.

These all agree in belonging to the eruciform type of larva. They are slug-like, legless, with the segmentation not well marked and the head not differentiated. They are of medium size, commonly about one centimeter long, sometimes considerably larger. They have no eyes and the antennae are very rudimentary. The mouth and anus are terminal or slightly ventrad at the two extremities. The esophagus has a more or less complex frame-work of chitinized parts extended to, or modified into, mouth-parts.

Typically the larvae bear anterior and posterior spiracles. I have not been able to locate anterior spiracles on the specimens of *Microdon* which I have examined. However, the anterior spiracles are often inconspicous in the other forms and, while they may be wanting here I suspect they may yet be found upon examination of more and better material. Buckton states that he was never able to trace a tracheal connection to the opening of the anterior respiratory cornua in the larvae of *Eristalis*. I am convinced that these spiracles are functional. Comparatively large tracheae run to them and are open to the tip; if a larva is submerged and compressed bubbles of gas may be seen to form in connection with the teeth-like lobes. There is no doubt that the similar structures in aphidophagous larvae are also functional.

In one type of larva which is exemplified especially by the aphidophagous species we have the tough-skinned, terrestrial larva with well-developed, beak-like, chitinous jaws and mouth-hooklets adapted for catching and eating their prey. In this type the anterior spiracles are

on a level with the body surface or very slightly elevated; the posterior ones situated at the apex of two short, rigid, firmly-chitinized, cylindrical breathing tubes which are always closely apposed (except in very young larvae), never bifurcated except very slightly at the extreme tip; this is one of the most characteristic things of this type of larva. The body is flattened ventrally, making a sort of creeping-sole, elongate-ovate in outline, tapering toward the anterior end. Pro-legs are wanting or very imperfectly developed as ventral folds of the body wall.

The indications of segmentation externally are groups of irregular, transverse wrinkles on which are situated, in each segment, typically twelve spines, hairs or bristles in a transverse row: three pairs dorsal, one pair lateral, and two pairs ventro-lateral. These I believe have never before been described. For convenience of reference (and to distinguish them from the minute, bristly hairs which sometimes cover the integument generally on the dorsal side which we may designate *integumental bristles*) I have pleased to call the former *the segmental spines;* and to name them, in order, beginning with the pair nearest the mid-dorsal line, and proceeding laterally: (a) *median*, (b) *dorsal*, (c) *dorso-lateral*, (d) *lateral*, and two pairs of ventro-laterals, a *posterior ventro-lateral*, (e) and an *anterior ventro-lateral*, (f) as one is in front of the other. (*Fig*. B.)

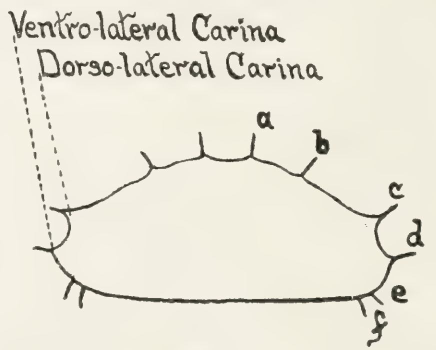

Fig. B.
Diagrammatic cross-section of an aphidophagous larva.

On the basis of the segmental spines nine segments can be clearly made out posterior to the one bearing the anterior spiracles. These spiracles may be considered prothoracic; hence we have ten segments exclusive of the head. The head segments are retractile, somewhat indefinite, with some appearance of being two in number. For convenience of reference, therefore, the total number has been considered as twelve, making the prothoracic segment number three.

The mouth-parts in this type consist of two V-shaped, jaw-like pieces working vertically; and several pairs (commonly three or four) of mouth-hooklets situated at the side of the jaws and adapted to work transversely. J. B. Smith (in discussing the larva of *Syrphus torvus*) refers to the larger of these mouth-hooklets as the mandibles, but I doubt very

much if there is any homology with adult mandibles. All these parts are black, firmly chitinized, and are continued internally into a broad, chitinous, esophageal framework, the whole operated by a complex system of muscles.

The antennae are very short, consisting of a single, fleshy joint with two, minute, rounded segments, side by side, at its apex. The pair of sessile, prothoracic spiracles each have typically a crescentric opening which may be guarded by rounded, tooth-like lobes.

The posterior respiratory organ, in this type, consists of two, short, cylindrical tubes united along the median line, very slightly divergent at the tip, situated on the dorsum of the last segment which is much depressed. They are firmly chitinized especially at the tip where each tube bears three slit-like spiracles raised on radiating carinae. Dorsally near the middle line, each is marked by a smooth, *circular plate*. Median to this plate is usually a spur or spine-like projection of the surface, the *dorsal spiracular spine*, and there are frequently elevations of the surface or other ornaments between the spiracles, referred to as *interspiracular hairs, spines or ridges*.

The colors of these larvae are commonly some shade of brown, pink or greenish marked with black or white. The integument though tough is thin and transparent and the dorsal blood-vessel almost always visible along the median line.

Of *Mesogramma polita*, which in the larval stage feeds on the cells and pollen of corn, I have not secured the larvae, but a careful study of puparia found at the Experiment Station Farm, West Raleigh, N. C., has revealed enough about the larval organization to show that the larvae of this habit are superficially quite similar to the aphidophagous ones; the general shape, size, and appearance being the same. Some of the detailed external anatomy, however, shows important differences from the aphidophagous larvae.

The mouth-parts could be only imperfectly made out but showed the presence of the beak-like arrangement of upper and lower V-shaped jaws (Fig. 191). The posterior respiratory appendage is essentially like that in aphidophagous species but peculiar in having the most dorsal of the spiracular slits with its elevation small and rounded, instead of transversely oval like the other two. I could find no trace of the *circular plate* so common in the aphidophagous form. There is little ornamentation of the appendage, only a short, inconspicuous, *dorsal spiracular spine*. The two tubes are somewhat divergent at the tip. A brief discription of the stages of *M. polita* will be found on pp. 66, 67.

In the type of larva adapted for aquatic or semiaquatic conditions, and represented by *Eristalis*, and others, the body is subcylindrical in shape, the integument very thin and pliable with a number of transverse folds falling into groups of about five each, between which the integument is smooth. Near the middle of each group is a transverse row of double, flexible hairs which are probably homologous with the single, usually rigid, *segmental hairs* or *spines* of the aphidophagous forms.

I take it therefore that these groups of folds or wrinkles indicate body segments. There are about seven such groups clearly indicated, and immediately in front of them open the anterior respiratory cornua of the larva. If we consider, as in the case of the aphidophagous larvae, that these anterior spiracles are borne on the prothoracic segments, and assume as in that case, two segments for the head, then this segment becomes number 3 and the last one of the seven would be number 10. To homologize the number of the segments with that which we attributed to the aphidophagous larvae (namely twelve) we may suppose that two segments instead of one have become modified at the posterior end into the long respiratory appendage and the part of the body which bears it and on which the alimentary canal opens.

These larvae have about six or seven pairs of well-developed prolegs which are ventral projections of the body surface over which the integumental vestiture has become specialized into heavy, rigid, curved and retrorse hairs of varying sizes.

There is absence in this type of larva, of hard external mouth-parts, the mouth opening being a soft, fleshy buccal cavity.

The body wall around the mouth is thrown out into several, rather specialized, soft retractile flaps or lips which have a habit of alternately opening out and introverting in such a way as to create a current of water toward the mouth.

Within these flaps is found a hood-like, striated, chitinous termination of the esophageal frame-work, which reaches the surface or can be seen without dissection. (Figs. 138, *b*; 139) Internal to this are located certain hard, black, chitinized structures which it seems to me may be homologous on the whole with certain of the external mouth-parts of the aphidophagous larvae (Figs. 140, 141), migrated in position and somewhat degenerate.

The antennae of this type are similar to those of the aphidophagous larvae, but the two small segments at the tip are rather elongate, cylindrical, rather than spherical, and slightly different from each other.

The most striking modification of this type of larva, however, is in the elevation of the spiracles above the general body surface. The

anterior ones are moderately elevated, borne on a pair of horn-like prominences which are capable of considerable extension but are usually rather closely retracted. The posterior respiratory appendage is a most remarkable and highly specialized organ which enables the larva to feed at various depths beneath the water without coming to the surface for its aerial respiration. The spiracles are situated distally on an elongated, tube-like appendage which is extensile and retractile in a telescopic manner. It is composed of three segments of different calibre, each double in nature, enclosing two trachea, but fused mesad and always parellel, never forked. These sections disappear one within the other when the appendage shortens.

The tip of the tube bears the spiracles and is ornamented with structures which serve to keep it from being submerged, and are probably homologous with the inter-spiracular ornamentation of the aphidophagous type.

A peculiarity of the larva of *Eristalis* spp., which may or may not be true of all "rat-tailed larvae" is the presence about the anal opening of a group of soft, retractile, radiating flabellae or long flexible finger-like processes, (Fig. 137). They may be entirely retracted and are at intervals rapidly unfolded. Buckton suggests that they may have a renal function.

The larvae of *Microdon* are perhaps the most peculiar of all Syrphidae although they seem less aberrant from the aphidophagous form than do the "rat-tailed" larvae. They are elliptical in outline, convex above, flattened ventrally to make a flexible creeping-sole. The integument is very tough dorsally, and this part of the body is often ornamented with a reticulate pattern of papillae or setae. The margin of the body around the creeping-sole is ornamented with a fringe-like arrangement of spiny, hair-like processes. (Can these be migrated homologues of the segmental spines?) According to Wheeler—"usually no traces of segmentation are to be observed, but in some adult larvae of *M. tristis* just before pupation, and after their upper surfaces had been dried by exposure to the air, I have been able to discern in certain lights a distinct division of the body into seven or eight sub-equal segments." This is about the number of segments which is usually clearly visible in both the "rat-tailed" and aphidophagous forms.

The mouth parts in the larvae examined may be understood by reference to Pl. IX, Fig. 181. It will be seen that they are not directly comparable to those of aphidophagous larvae. The structure at *d.* is probably equivalent to the lower jaw of aphidophagous ones. It has in addition a flap-like piece at each side which gives the jaw a triple ap-

pearance. It is possible also that the structures *(c)*, are comparable to the upper jaw, or they may be equivalent to lateral hooklets ("mandibles" of J. B. Smith). In front of the mouth-parts on the ventral side of the body is a pair of structures which I believe are antennae. They would compare with the antennae in the other forms with the two apical segments much elongated and tapering at the tip, the basal part not prominent. I have not been able to find anterior spiracles in the larvae I have examined. There are no signs of pro-legs.

The posterior respiratory appendage resembles in superficial appearance that of aphidophagous species, consisting of two, fused, short, rigid tubes. The essential structure however is quite different. In place of three pairs of slit-like spiracles we have an arborescent pattern such as is figured in Pl. IX, Fig. 184. The colors of these larvae are usually a dirty white or drab tinged with yellow or brown.

### CHARACTERS AVAILABLE FOR CLASSIFICATION

Though distinct as a family, the larvae of *Syrphidae* do not present easy specific characters. It is often much easier to recognize the species by a *tout-ensemble*, than to define the characteristics. In the aphidophagous forms the color and vestiture are helpful. The mouth-parts and anterior spiracles doubtless present constant differences, but these are small. On this account and because of the habit of the larvae of retracting their head segments, these parts are exceedingly hard to see clearly. Hence they are almost worthless for the ready distinction of species. The number of mouth-hooklets seems to vary somewhat, and their size, shape, and location, as also the length and shape of the jaws, is constant for the species, but varies somewhat among the different genera and species. Of these characters probably the only one easily enough made out to be of service is the presence or absence of a pair of large hooklets, remote from the side of the jaws, which I have called *the outer pair of mouth-hooks*. These for example are wanting in *Didea fasciata*, and present in the three species of *Syrphus* and the two of *Paragus* which I have examined (Figs. 3; 11, c; 23, a; 47; 67, c; 81, d; and 91, a;). The ornamentation of the anterior spiracles (Figs. 12, 48, 83, 92,) seems to differ. However, after spending considerable time, with strong illumination and high microscopic powers, in determining the actual nature of this character in a single specimen, I concluded that it would be of little use for the practical separation of the species.

We have come to the conclusion that the best available, and perhaps the only absolutely dependable, basis of separation for aphidophagous

species is in the character of the posterior stigmata or respiratory organs. These are of a fair size; are always exposed in larval as well as pupal stages; present a really surprising variety of characteristics; and, being well chitinized, the characters are tolerably constant within specific limits. In these stigmata one may note the approximate length of the whole projection; its exact width and depth; the extent of elevation of the slit-like spiracles; their exact length and width; their arrangement with respect to each other; the amount of divergence of the two approximate, cylindrical tubes at the extreme tip; the character of spinous and other ornamentation, etc., etc. The nature of the ornamentation between the spiracles varies from sharp, leaf-like, erect, irregular ridges, to sharp or blunt spines, to hairs or bristles, and is of the greatest value.

It is much to be regretted that in the few cases where immature stages of *Syrphidae* have been described, these characters have not been noticed or were not considered of sufficient value to be recorded. It is desirable that these few species be again gone over in this light so that there may be an accurate basis for distinguishing our species.

The "rat-tailed" larvae doubtless will be found to present sufficient characteristics for specific separation. Something may be made of the size, general shape, color and appearance. In this case, anterior spiracles or respiratory cornua are of such a size that careful examination will usually show clearly their microscopic structure, and this may be used. (Figs. 112, 113 of Plate VI, Fig. 132 of Plate VII). The posterior respiratory appendage also will be found to vary in structure and appearance and the pro-legs may vary in number. Another point of which much may be made, I feel sure, is the vestiture of the various parts of the body; the hooks on the pro-legs, those on the several segments of the "tail" and the character of the ornamentation at the tip of the latter. (Note Figs. 138, *c*; 133, 135 of Plate VII). It is almost certain that the larvae of *Microdon* can be separated by the characteristics of the reticulate ornamentation of the dorsum, the fringe-like border of the body, the stigmatic pattern on the posterior respiratory appendage, etc. General size, shape and proportions ought to be of considerable use in larvae of this kind where the body is rather rigid and seemingly must hold to almost a constant position.

There is such great diversity of structure among the larvae with different habits that until more of them are studied it will be impossible to construct a phylogenetic table. For reasons which are stated in the discussion of larval habits (pp. 38-40), I believe the phytophagous larvae to be most primitive in habit and they may be considered the most generalized of the group structurally. It must be remembered of course

that any Syrphidous larva is a very specialized creature and the larvae of the various habits undoubtedly derived their structure from an ancestral form much more generalized than the phytophagous larva of *Mesogramma polita*.

The larvae of the aphidophagous habit are structurally but comparatively little removed from the phytophagous ones although there are important differences in the minute anatomy of the two.

The larvae of *Microdon* while extremely specialized are in a general way nearer to the phytophagous and aphidophagous forms than are the rat-tailed larvae. The body of *Microdon* is broader than that of *Mesogramma* and the aphidophagous species, lacks the segmental spines and possesses a very highly developed marginal fringe. The respiratory appendage is very similar in general appearance, but the stigmatic arrangement is quite different.

The rat-tailed larvae are extremely specialized in adaptation to aerial respiration while living in an aqueous medium. There apparently can be little doubt that the posterior respiratory appendage in all these forms of larvae had a common origin. The primordial representative of this structure was probably the simple termination of the two tracheal trunks. These probably became separately elevated above the surface, making two posterior tubes; then shifted in position until they became apposed, then united basally and now in the entire family they are united mesad thruout their full length. This structure, at first of moderate length, soft and easily modifiable, has now been modified into the short, strongly chitinized structure of all the terrestrial forms, and on the other hand into the long, flexible and telescopic organ of the aquatic larvae. Each structural group has developed its own arrangement of special spiracles.

The chitinized structures internal to the buccal cavity in *Eristalis aeneus* (Pl. VII, Figs. 140-141), if they represent mouth-parts at all, are quite degenerate. And finally in the rat-tailed species we have ventrally projecting folds of the body wall, such as those in *Syrphus americanus*, specialized into very efficient pro-legs.

*Microdon* and *Eristalis* differ from the phytophagous and aphidophagous species in having an anterior pair of pupal respiratory cornua developed.

Moulting of the larvae is inconspicuous, probably consisting of a somewhat continuous process of shedding flake-like pieces. The conspicuous change from young larvae to older in *S. americanus* is evidence that a moulting does occur. Owing to the fact that in some species several

generations occur in a year and become to some extent confused, the date of the appearance of young can not be stated in a general way for all species. Some of the aphidophagous species, whose stages have been worked out, were studied only in the autumn generation. The larvae of this generation occur quite generally in the latitude of Ohio from the middle of September to the middle of November, or even later, depending on the season. Some species were found, as larvae, as early as the first of May, and others very commonly during June. Larvae of certain species seem most abundant during June, July and August.

Duration in the larval stage in those species for which I have records varies from one to three weeks and seems to be determined in part by the amount of food at hand.

Wheeler states that young larvae of *Microdon tristis* may be found in the nest during July; that these mature by autumn and after passing the winter in the ant nest, pupate in April or May. There is, in his opinion, only one annual brood in temperate regions, the adults emerging in June. The larva of *Mesogramma polita* is said by Ashmead to mature in from eight to ten days.

Those species which as larvae are predaceous, are to be looked for wherever small soft-bodied *Homoptera*, especially *Aphididae*, occur in colonies. They are to be found alike on trees, shrubs, herbaceous plants, weeds, field-crops and garden-crops. The phytophagous species have been found on corn, working either between the base of the leaf and the stem or on the tassels. The larvae of *Microdon* live in the nests of ants, wasps, or termites, either in the soil, under stones, in decaying logs or in cavities in or under the bark of trees. In the United States the most frequent hosts are probably species of *Formica*.

Species of *Eristalis* were found abundantly in evaporating vats at the Columbus sewage-disposal plant where sewage in an advanced state of decay is left exposed for some time. They are to be found in all sorts of foul or stagnant pools, in organic debris, excrement, ooze about drains, in watering troughs, etc. Other "rat-tailed" species, e. g. *Mallota* sp., are said to live in decaying wood or trees.

The habitat of others may be noted from the outline of larval habits given below, p. 38, and ranges from various positions on or within living plants, including bulbs, cacti, and fungi, thru decaying wood or exuding sap, decaying vegetable matter, manure, and soft mud impregnated with decaying organic material, to a strictly aquatic condition in stagnant or foul water. Another line of specialization from the same original habitat has taken up the predaceous habit; certain specializations from this have

led to a close, obligate predatism on aphids in galls, and there has been reported a case of internal parasitism. Still others live in nests of certain *Hymenoptera*.

The kind of food varies as much as the habitat, from living plant tissues or sap thru decaying wood, to all kinds of decaying organic matter or excrement; and, on the other hand, to living soft-bodied insects. So far as I know none of the aquatic larvae have been observed to feed on minute animals or plants, except possibly on algae (see pp. 46,70).

Some of the aphidophagous species seem to be rather omnivorous. The larvae of *Syrphus americanus* and *Allograpta obliqua*, which have been rather more carefully studied in this respect than the others, were each found preying on three to six different species of Homoptera. *Didea fasciata* on the other hand was found, in the larval stage, preying only on one species (*Longistigma caryae*) of *Aphididae*, and the gall infesting species seem to be essentially restricted to one species of prey.

These aphidophagous larvae, although frequently found entirely surrounded by an abundance of prey, are very often obliged to search about for food. Their characteristic, looping movements are very familiar to many people. When used for progression alone, these movements may be very rapid. Their progress is very similar to that of a "measuring-worm" though the body is not so long. When the larva is searching for food, the anterior half or two-thirds of the body is raised in the air, very much extended, and lashed from side to side. It is then attached and the posterior parts pulled up, when the movement is repeated. Thigmotropism, and not chemotropism, seems to be involved in locating food. Hungry larvae frequently pass by aphids so closely as almost to touch them, and go on in search of others. When a suitable aphid is found the larva frequently grasps it first by the leg or antenna and clings to this appendage until the thorax or abdomen can be reached. The mouth-parts are firmly attached to the body, the body-wall is punctured, and the aphid usually lifted high in the air. Then begins a process of slowly picking and sucking out all the body contents, which may continue from a few minutes to more than an hour (in the case of very young larvae). The action of the mouth-parts is very characteristic and very well adapted to the needs of the case. Many different muscles, which have their origin on the body-wall in the region of the head, are inserted upon the esophageal frame-work, the jaws, and the mouth-hooklets. Some of them operate the framework in and out like a battering ram. Others at the same time open and close the jaws. The anterior two or three segments are inserted completely within the body wall of the aphid. The jaws are

directed into every corner of the body and even into the bases of the appendages as they pick and suck out the soft contents. The skins, absolutely empty, are then discarded by retraction of the segments, the hairs or spines on those outside serving readily to dislodge the skin. These dead skins usually drop down or blow away but may sometimes be seen in numbers on the host-plant.

As described above, the larvae of *Eristalis* spp. have rather specialized, soft flaps around the mouth which have a habit of opening out and folding in, so as to create a current of water toward the mouth. Particles suitable as food are doubtless selected from the current by the action of the "lips."

As described by Ashmead the larvae of *Mesogramma polita* elongate the anterior segments, protrude and puncture the saccharine cells of the corn and suck up the exuding juice.

The mouth of the larva of *Microdon* is located in the midventral line near the anterior end of the body. There is little more than a longitudinal slit, within which the mouth parts are located. A very slight fold in front of this, however, bears the structures which I believe may represent antennae. Wheeler states that in life the anterior end of the body is occasionally raised for a few moments and one may see the small pointed "head" of the larva moving about uneasily under the fringed border as if in search of food. The mouth-parts consist of chitinized structures which are evidently suitable for prehension and mastication of food particles.

The stout, formidable-looking spines of some larvae, as in *Didea fascita* and *Paragus bicolor*, may be protective. Some larvae take up protected positions on the under side of the leaves and twigs of the host-plants or, in the case of cabbage, they are sometimes found among the inner leaves, or at the axils of the outer leaves. It seems certain that the tough skin and spine-like ornamentation of the larvae of *Microdon* are protective. Wheeler relates that in an artificial formicary the ants "killed a young larva that had failed to get hold of a surface with its vulnerable creeping sole. They turned the helpless creature over on its back and for two days kept licking and biting it till it was reduced to a mere granule."

The larvae of certain aphidophagous species present what seem to me to be good cases of protective coloration. In a general way it may be said that these larvae are never conspicuous. Generally they are more or less completely surrounded, or covered, with the aphids on which they are preying, and therefore easy to overlook. But in some cases there is added to this a very close similarity in coloration between the larvae and the

parts of the host-plants on which they are resting, or occasionally a color pattern which blends remarkably well with that of the aphid-infested leaf, stem or twig. Larvae of *Allograpta obliqua* and *Sphaerophoria cylindrica*, for example, are concolorous with the cabbage leaf and cabbage aphids; and the former nearly so with the persimmon leaf. A better case, however, which has come to my notice, is that of the larvae (*Syrphus* sp.) described in Part II, pp. 55-56. These larvae were often found curled about among the flowers on the spike. Their colors of deep green and pinkish, assisted by their irregular shape, harmonize almost perfectly with the similar colors of the flowers at this time. Although the larvae were nearly an inch long, they were so inconspicuous that the first time I collected them I examined some of the spikes several times before locating certain larvae; and the next day I was surprised to see still others crawling about in the jar that I had not found previously.

## GENERAL CHARACTERS: THE PUPA

The pupa is aerial or subterranean. This stage is passed within a puparium made by induration of the larval skin; and generally retains many of the characteristics of the larval stage. This skin, I believe, always becomes more or less inflated dorsally and anteriorly and shortened along the ventral line.

The larval respiratory structures do not seem to function in this stage, at least not near its completion. The tracheae from both the anterior and posterior pair become constricted off and flattened against the inside of the puparium, outside of the delicate nymphal membrane.

In the case of *Eristalis* and *Microdon* a special pair of prothoracic cornua are developed for pupal respiration; and judging from the published notes, this is probably true of *Volucella*, *Helophilus*, *Mallota* and *Xylota* as well. As pupation approaches in *Eristalis*, they appear first as round dark areas of the body-wall, later pushing out to a length of several millimeters. They are located on the fourth body-segment or the body-segment just posterior to the one bearing the anterior larval respiratory cornua. The latter also elongate but always remain shorter than the pupal cornua. The pupal structures connect internally with trachea which clearly lead to the dorsal part of the prothorax of the developing adult, (See Fig. 146a, Plate VII). Wheeler states in discussing *M. tristis*, "When the time for pupation arrives .... a pair of short tubercles or protuberances make their appearance near the anterior end in addition to the single respiratory tubercle at the posterior end." It will be recalled that anterior larval spiracles have not been demonstrated for *Microdon*.

The aphidophagous species also dispense with the larval structures, both the anterior and posterior tracheal connections apparently becoming constricted off. But in this type there is no evidence whatever of the development of special spiracles for the pupal stage.

In the aphidophagous species the puparium becomes more or less barrel-shaped or roughly conical, bulbous in front and tapering behind to the posterior respiratory organ which remains as in the larva or may protrude farther.

The rat-tailed puparia are generally more elongate and less inflated dorsally than the aphidophagous ones, somewhat cylindrical in shape. The "rat-tail" is usually fixed in a curved position over the back, while in front are the two pairs of short respiratory cornua, the more anterior pair being the shorter.

In *Microdon* there is apparently less change from larva to puparium than in the other forms. A slight amount of dorsal inflation, a general hardening of the integument, and the appearence of a pair of respiratory cornua at the anterior end constitute the external change from larval to pupal stage.

The appearance of puparia in this family is thus rather characteristic. The "barrel-shape" of many of them; the hard, somewhat vitreous surface of the pupal envelope; the short apposed tubes, or the long rat-tailed structures, of the posterior respiratory organs, as well as the anterior respiratory cornua of certain forms, are distinctive characters.

### CHARACTERS AVAILABLE FOR CLASSIFICATION

As a basis for specific separation we have practically all of the characteristics of the posterior respiratory appendage of the larva remaining the same. This structure may also assume new characteristics worthy of note, such as greater prominence, color of certain parts, etc. Since the puparium is a rigid structure, its shape and dimensions may be of considerable value; as, for example, the proportion of height to width or length, or the curve of the inflation anteriorly and posteriorly as seen from the side. The mouth-parts, and in the aphidophagous species, the anterior spiracles are usually unavailable. In the case of the rat-tailed species, however, the anterior larval and pupal respiratory cornua both present characteristics of great value. Their shape and size as well as the microscopic ornamentation of them can doubtless always be used to separate the species. In the case of *Microdon* spp. we have the anterior pupal respiratory cornua without a doubt varying in size, shape, and microscopic ornamentation. Most of the characteristics of the larval stage can also be used.

It is a very general thing among the aphidophagous species for pupa to be formed early in the summer and again in autumn. But definite statements can be made only for particular species. Some of the species, perhaps many of them, have at least two generations a year. The pupae of *M. polita* were found in Florida in late May, in New Jersey in early September and at Raleigh, N. C., in late September. *Microdon tristis* pupates in April or May according to Wheeler. *Eristalis* spp. pupated in large numbers at Columbus in early autumn.

The duration in the pupal stage varied in the aphidophagous species I studied from 48 hours to 20 days. A much more frequent length of this stage was from four to ten days. The pupal stage of *Mesogramma polita* lasted eight to ten days (Ashmead).

The puparium is usually fastened by an adhesive secretion from the anal glands of the larva to some exposed object: a part of the host-plant in the aphidophagous type, a stone or other object well above the water in *Eristalis*. In the case of *Syrphus americanus* pupae kept indoors were found buried under a half-inch or more of soil. This subterranean habit has also been noted in the pupae of *Eristalis* and *Helophilus* spp. The larvae of *Microdon*, "when they reach maturity and are ready to pupate emigrate to the surface ........remain stationary, attached to the walls of the galleries by their creeping soles, and are then found near or at the entrances" of the nests. The pupae of *Mesogramma polita* were found in Florida and Missouri attached to the upper surface of a corn leaf near its base and between the base of the leaf and the stem. At Raleigh, N. C., puparia were found fastened on the tassels of corn; in size, shape and coloration they strikingly resembled the flowers themselves.

The hard, more or less impervious pupal envelope with the long and formidable-looking spines which are sometimes present, must be an excellent protection for the developing nymph during this stage. Usually, also, a more or less protected position is chosen by the larva in which to accomplish pupation: either a sheltered nook among the leaves, flowers or bark, or in some cases in the ground.

Within the puparium, the coarctate pupa (Plate IV, Fig. 54) is covered with a delicate transparent membrane (Fig. 54 *a*) with pockets encasing the developing legs, wings, etc. The changes visible externally are gradually produced and give little indication of the radical internal histolysis and histogenesis.

The appendages, such as legs, mouth-parts, and wing-pads differentiate very early, while the whole abdomen and the dorsal part of the body is still a mass of fatty granules, with the position of the dorsal blood-vessel

indicated as in the larva, and the head and eyes are simply irregular, angular masses. The antennae and eyes are next differentiated. The tracheation and venation of the wing-pads then becomes evident; and finally the segmentation of abdomen, the vestiture, and last of all the adult coloration appear. The thorax is one of the last parts of the body to assume the adult shape and appearance. During this stage the hind leg presents a peculiarity in that the tibia is bent just beyond the middle at an angle of about 150 degrees. This shortens the extent of this leg posteriorly.

The pupae of *Eristalis* spp. differ from the aphidophagous ones in bearing on the prothorax dorso-laterally, the tracheae which lead to the pupal respiratory cornua, (Plate VII, Fig. 146). This is doubtless also the case in the genus *Microdon* and others.

The emergence of the adult often takes a considerable time. The newly emerged imago has its wings much crumpled and folded, in area not more than one-fourth as great as when fully expanded. There is a prominent U-shaped loop in the costal margin near the middle. The body is usually much hardened by the time the fly is completely free from the puparium; yet perfect induration, expansion of wings, and coloration are sometimes not acquired (indoors at least) for an hour or more.

## GENERAL CHARACTERS: THE ADULT

The different species vary very much in form and appearance. They are medium to large-sized flies, only a few species being small. The head is always large, as broad or broader than the thorax; the face excavated under the antennae and projecting below or with a distinct convex tubercle near the middle; front never excavated, often swollen. Antennae three-jointed, the third joint variable; usually compressed and with a dorsal bristle, bare or plumose, but sometimes instead of bearing a dorsal arista, the third joint tapers off into a terminal style. Eyes bare or pilose, usually contiguous in the male between antennae and ocelli; ocelli always present, three in number. Thorax moderately large, barrel shaped, with a large scutellum. Tegulae of moderate size. Abdomen varies from slender and linear to clubbed, or short, broadly oval, and flattened; of five or six, rarely four visible segments. Legs usually weak, sometimes strong; the hind femora, especially, often moderately or much thickened. Bristles (macrochaetae) almost always wanting, the body either bare, thinly pilose, or clothed with thick pile. Wings comparatively large; third longitudinal vein (cubitus) never forked; fourth longitudinal vein terminates in the third; three posterior cells; anal cells close before the border of the wing; basal cells large; *between the third and fourth longitudinal veins and nearly parallel with them there is a false or spurious vein,*

nearly always present and characteristic of the family. The post-alar membrane, or squamae, with peculiarly-formed, forked, and fan-like ciliation; and the plumula (an elongated, fringed, filament-like projection from the upper margin of the pteropleurae beneath the squamae) are peculiar to the *Syrphidae*.

The mouth-parts of the adults (See Plate VIII, Figs. 153-7) do not seem particularly well adapted either for lapping up nectar or for the prehension or ingestion of pollen grains. The labrum-hypopharynx is somewhat lancet-like as though it might serve for piercing plant or animal tissues (See Fig. 156). But such a habit is known at the most for only a single species (See p. 35); while an examination of stomach contents has indicated honey and pollen-grains in abundance. The oral opening is large, the proboscis usually short and, when at rest concealed within the mouth. The maxillae (Plate VIII, Fig. 154) show a blade-like maxillary lobe and bear a somewhat flexuous, one-jointed palpus. The labium is short, cylindrical, unfolding in a hinge-like manner, expanded at the tip into a bilobed labellum or lapping tongue provided with tracheae (Plate VIII, Fig. 153). The whole acts like a sponge, the nectar rising by capillary attraction. The antennae of the adults bear remarkably complex and symmetrical olfactory pits indicating that this sense is well developed. These pits (See Plate VIII, Fig. 160, 161) are open and their walls are lined by a large number of olfactory pegs or perceptory end organs which send nerve fibres in to the central ganglia.

While the colors are various, the species of this family are characteristically marked with yellow, in spots, bands, or stripes, on head or thorax, but particularly on the abdomen. Many of them resemble *Hymenoptera* and are to be found about flowers, hovering in the air like hummingbirds, or crawling about over the blossoms in search of nectar and pollen.

The one character by which anyone can distinguish *Syrphidae* from all other flies is the so-called "false or spurious vein" which is a thread-like thickening of the wing-membrane, between the third and fourth longitudinal veins and running thru the anterior cross-vein, (Plate VIII, Fig. 151). It has the general apperance of a vein but is not so clear-cut nor so deep in color and its outer end, at least, is free. It is present in all but a very few *Syrphidae* and not found in the members of any other family.

Secondary sexual characters occur on head, legs and abdomen, and are absent from the thorax and wing. None of them seem to be characteristic of this family. Many are of use as generic characters.

Most of the males are holoptic. In a few genera (*Microdon*, *Chalcomyia*, *Triodonta*, *Mallota*, *Helophilus*) the males are dichoptic; but even then the front is different, always narrower and forming some angularity with the eyes, in the male, broader and with the margins straight in the female.

In the legs are found the most important secondary sexual characters; it is the male legs which are modified. Some of these specializations are probably of value as seizing or clasping organs during copulation, and hence, unlike most of the others, present some evident utility. The front pair are modified in a few cases (notabaly *Platychirus*); the middle ones rarely; the hind ones most extensively.

In coloration and vestiture there are very frequent secondary sexual differences. In general, where there is any difference, the male is more strongly or brightly colored, though the females are by no means somber in this family. The male is also frequently more strongly or thickly pilose.

## CHARACTERS AVAILABLE FOR CLASSIFICATION

In adult *Syrphidae* one finds a great variety of characters peculiar to genera and species and hence available for the purpose of bringing related forms together. Apparently the most fundamental are those of the wing. The various features of the head are of constant service. The legs present a number of excellent characters. The abdomen (shape and especially color pattern) has constantly to be drawn upon for specific characters. While in not a few cases the thoracic features are of value.

The characters of the neuration of the wing are especially constant and reliable and have been extensively used. The position of the cross-veins, and the shape, curvature and termination of the second, third and sixth longitudinal veins, are of fundamental value; while the size and shape of certain cells can often be used to advantage in the separation of closely allied forms.

Probably more characters are derived from the head than from all other parts of the body. Characters of the antennae, of the front and face, and of the eyes are all much used.

The antennae as a whole may be elongate or short: the third segment varies much in size and shape, may bear a style or an arista, and the arista varies in position and in vestiture from bare to pubescent, pilose, or plumose. Williston notes that species with elongate antennae are not very active in habits. On the front and face are to be noted length, breadth, projections, wrinkles and grooves. The size and shape

of the eyes, their pilosity and the size of the facets are somewhat unstable, but often useful characters.

From the thorax we occasionally get characters in the shape or ornamentation of the scutellum. In the legs, length, thickness of special parts, vestiture, peculiar spines, etc., are of value, though often confined to males only. In the abdomen, shape, flattening, length, width and depression, and occasionally peculiarities of certain segments and of the hypopygium, are to be considered. Williston makes the interesting observation that the species with slender abdomen are quickest on the wing, the short, thick-set ones never soaring but commonly resting on flowers and leaves.

Color-markings are very extensively used in this family both as specific and as generic characters. In some genera they are very reliable, in others practically worthless. In general it is best not to rely upon them unless coupled with definite structural characters.

Macrochaetae are conspicuously rare in this family, and hence the vestiture is of decidedly secondary importance. A few genera have bristles; elsewhere the only characters are relative density or scarcity of pile or pubescence; or the pollenosity of special parts.

The adult insects of many species have several periods of common occurrence each season. Little can be said in a general way about these dates. We have been much surprised to find how early in Spring, adult *Syrphids* may be taken. In 1910 and 1911 a number of species were taken the last few days in March and the first of April about blossoming Willow (*Salix* sp). Some species are probably active as soon as the first flowers bloom in spring, and some are to be found all summer long, and as late as November in autumn.

I am not aware that there are any accurate observations as to the length of life of the adults. I found the *Syrphidae* did not thrive in captivity, and though they could be kept alive for a short time on sweetened water, they were very readily killed by adverse conditions. Buckton, however, relates an instance in which a decapitated *Eristalis tenax* lived for three days and nights on a microscope-stage. Certain observations lead me to believe that the adults do not ordinarily pass the winter.

In consideration of the very remarkable divergence of larval habits it is suprising to find that the adults almost all have the same, or very similar, habits of life. Larvae which are predaceous, phytophagous, aquatic, or live in the foulest of excrement, all transform to adults which are characteristically attracted by two things, viz., flowers and sunshine. Not many kinds of imagos will be taken away from flowers and not many are

active on dull days. But, given a warm bright day and fragrant melliferous flowers, and many species, especially of *Syrphinae* and *Eristalinae* may often be taken in a short time. In fact the great majority of species, so far as we know, are dependent on honey and pollen for food. Some, however, as the *Chilosini*, *Xylota*, *Chrysogaster*, *Neoascia*, do not so much appear in the open about flowers, but are to be looked for among the foliage of low bushes, in damp places, or in low meadowy woods. Species of *Mesogramma* can sometimes be taken in large numbers by beating grasses in woody meadows.

It frequently happens that immense numbers of adults of one or several species emerge at about the same time; and this is doubtless responsible for the records of "swarming" of species of *Syrphidae*. During the first Spring days one finds them about flowers in very great numbers, but they are said to swarm in the sunshine irrespective of feeding as an object.

W. D. Hunter, Canad. Ento. XXVIII, 99, reports observing a male of *Eristalis flavipes* sucking the substance of a small grasshopper, *Chloealtus curtipennis* which was held in its grasp after the manner of many of the *Asilidae*. If this really indicates the predaceous habit, it is, so far as I can determine, an isolated example of divergence from the feeding habit mentioned above.

## METHODS OF NATURAL PROTECTION

If there are in nature such things as terrifying coloration and mimicry, we have among *Syrphidae* some excellent examples. Perhaps seventy-five per cent of these species, and a much greater per cent of the individuals commonly seen, more or less closely resemble the popular idea of a wasp or bee; that is, they are brightly banded, transversely, with black and yellow on the abdomen, or are thickly pilose with the same colors. Resemblances in shape, also, are in a good many species very striking, and important in increasing the effect of similarity. I have been interested in noticing how many people, when shown a collection of *Syrphidae* or a live specimen, at once pronounce them "bees" or express the belief that they can sting. Also in a class of elementary students in Entomology the percentage who at first place their *Syrphid* specimens among the *Hymenoptera* is very great. It is often rather difficult for one to tell whether a specimen flying about flowers is a *Syrphid* or a *Hymenopteron*.

Now it is supposed that enemies of insects learn by experience to avoid those forms which are provided with stings or are in other ways distasteful or unpleasant to them. The more striking the recognition mark of such forms, the fewer the number of individuals that will be sacri

ficed in the acquiring of this experience. If any badge comes to stand generally for an unpleasant experience, the species possessing it will be left unmolested, and so, to some extent, will be other forms though lacking in the unpleasant or distasteful quality, if they possess the same sort of markings. This will be true only so long as the distasteful form exceeds in individuals met with, the harmless form; and the greater the preponderance of mimicked individuals the better the protection of the mimicker.

Now it seems to us that the one badge, which, to the human eye at least, suggests the unpleasantness of a sting, is the black and yellow abdominal markings mentioned above. Is this not also true of the predaceous enemies of *Syrphidae*? If so, we have perhaps an explanation, or rather a utilitarian justification, for the existence of these resemblances.

It should be stated that this resemblance in color, pattern, and form is given significance by the similarity in habit of many of the two groups. Both are to be found buzzing or hovering about flowers, especially in the sunlight, or crawling in and out of the blossoms. The casual observer never distinguishes many of the *Syrphidae* from the numerous and varied *Hymenoptera* always to be found about melliferous blossoms.

Of course the most striking structural difference between these two groups is the presence of four wings in the bees, and only two in the flies. The structure of the mouth-parts is also very different. But these are by no means the most ready ways of distinguishing the two in the field. The *Syrphidae* have a distinctive manner of flying which has given them the name of "Hover-flies." They constantly poise or hover in the warm sunlight like a hummingbird. They remain suspended in the same position for a longer time than a bee, apparently without moving their body at all, and with wings beating so rapidly as to be practically invisible. Or they dart away suddenly, seeming to keep the body always in a tense horizontal position. In the case of a bee there is habitually more or less weaving back and forth of the body and bobbing up and down.

This is one of the ready means of distinguishing these insects in the field. Again the long, elbowed antennae of a bee are comparatively conspicuous when it is in flight; while, of course, the short ones of the great majority of the *Syrphidae* are not visible at a little distance. Another thing worth noticing is that when at rest on flower or leaf, the *Syrphid* will frequently keep its wings half spread, ready for flight; while those of the bee are closely folded or crossed over at the tips.

A few of the best cases of protective mimicry might be mentioned. That of the drone-fly, or chrysanthemum fly, *Eristalis tenax*, is known

to everyone. This species in general color and size, in proportion of head to thorax to abdomen, in vestiture, in size and proportion of the wings, and distinctness of the veins, in manner of buzzing about flowers; in fact, in almost every respect except the length of the antennae, is a striking mimic of the honey bee (*Apis mellifera*), especially of the drone.

A few other of the more striking resemblances may be named: *Temnostoma alternans* to *Vespa diabolica*, the yellow jacket; *Spilomyia fusca* to *Vespa maculata*, the bald-faced hornet; *Volucella evecta* and *Eristalis flavipes* to *Bombus* spp. bumblebees; and *Ceria abbreviata* to *Odynerus philadelphiae*. The list might be extended to considerable length by a comparison of numerous specimens from the two groups.

## REPUTED AGGRESSIVE MIMICRY

Some of the species of the Genus *Volucella* resemble, in the adult stage, certain bees and wasps; and the larvae of several species are known to live in the nests of the large Aculeate *Hymenoptera*, especially in Europe. It has long been supposed that the larvae lived on the immature bees in the nest and that the resemblance was of great significance in enabling the parent flies to enter the nests of the bees for the purpose of oviposition without being detected and antagonized. Folsom and others refer to this as an instance of Aggressive Mimicry which has resulted from the action of natural selection. This seems however not to be founded on observed facts. The larvae live in the bees' nests, and the adults, which resemble the bees, enter the nests to lay their eggs. In doing this they met with no resistance in the cases observed. Erne who watched the *Volucella* larvae in the nests, thought they acted as scavengers, eating the waste and excrement of the larvae. Sharp, who kept some of the larvae under observation, found that they starved without eating the honey, or the larvae and pupae of *Bombus*, which were provided for them; that they did not attack the pupae of wasps in the comb; but that when a pupa of the wasps was broken in two, they attacked it eagerly.

We must therefore believe that these larvae live on either excrementitious matter or on pupae which have recently died, thus preventing the contamination of the nest; and hence that, however the resemblance of the adults to the bees is to be explained, it is not now aggressive mimicry. Is the theory not barely tenable, however, that the habits represented by *Volucella* and *Microdon* (though not now predaceous) have been derived from a true predatism by a specialization in which they began to eat the injured, or dead, or more or less putrified bodies of larvae and pupae, and excrementitious matter in the nest, rather than the living young? If we could hold to this view we would have an explanation of the excellent

cases of mimicry by *Volucella* spp. of the host bees in whose nests their larvae live. The resemblance thus established by natural selection would continue, but with the change of larval habit might come to stand as a badge of friendship for the bees. Natural selection might operate to perfect a resemblance so established, in the manner accredited to ordinary protective mimicry. (See also pp. 40, 47.)

## AN EVOLUTIONARY TABLE OF LARVAL HABITS

The metamorphoses of the *Syrphidae* are still very imperfectly known. This important field has merely been touched upon by isolated workers in Europe and in North America. What little has been done is sufficient to prove that (unlike the adults) an exceedingly interesting and remarkable diversity of habit exists, in the larval stage, among the different genera and species.

Williston (1886) gave eight distinct classes of larval habits and cited a few genera as known to him to each class. What follows is an attempt to list, in tabular and evolutionary form, our present knowledge of larval habits; it is based on Williston's classification and for many of the additional notes I am indebted to Verrall.

From a consideration of the various larval habits in this family and what we know of the habits of many, much more primitive, less specialized larvae in other groups, it seems likely to me that all the habits here represented have been derived from an ancestral condition in which larvae with mandibulate mouth-parts lived externally on the surface of vegetation of one kind or another, eating parts of the leaves or other plant tissue. (See Fig. C. p. 41). This habit may have been largely given up either before or after the group differentiated into what we would recognize as *Syrphidae*.

At the present time the habit is represented, so far as has been described, only by *Mesogramma polita* which feeds externally on the succulent cells of corn (*Zea mays*) especially in the region of the leaf-sheathes or on the pollen. (See p. 46.)

I. *Larvae living externally on plants and feeding either on the ordinary surface cells or on the specialized pollen grains; Mesogramma polita.*

This I believe to be the most primitive larval habit so far discovered. Verrall apparently considers this habit a specialized one, derived from the aphidophagous habit, to which the larvae are supposed to have been driven by the exhaustion of the supply af aphids. To me, this does not seem likely but rather, conversely, that the aphidophagous habit has been derived from the more primitive, phytophagous one, which is still followed by many of our most primitive larvae in other groups. From feeding externally on plant tissue it is a perfectly natural step to what I would make the second group.

II. *Larvae living within, and deriving their food from—*

(A) "*The stems of plants such as Sonchus, Scrophularia, Matricaria;* genus *Chilosia;*"

(B) *In cacti:* genus *Volucella;*

(C) *In bulbs,* as of Narcissus and Amaryllus: genus *Merodon;* or of onion: genus *Eumerus;*

(D) *In fungi* (as *Boletus edulis*): genera *Chilosia, Platychirus.*

Species which could feed successfully in this manner, especially those in fungi, lead very naturally to the third group. This group cannot be strictly separated from the succeeding one and the two might be combined. But the two lists of genera exemplifying these habits, as divided, are very distinct; and further this third group makes a very perfect and illuminating step in this line of evolution of larval habits.

III. *Larvae living—*

(A) *In decaying wood or trees, some of them "rat-tailed:"* genera, *Mallota, Spilomyia, Xylota, Brachypalpus, Pocota, Myiolepta, Chrysotoxum;* or

(B) *In sap flowing from injured or diseased trees:* genera, *Brachyopa, Chrysochlamys, Xylota, Ceria, Chrysotoxum, Myiolepta?*

(C) *Bred from larvae found under bark of oak:* genus *Crioprora* (by Osten Sacken); *of cotton-tree:* genus *Xanthogramma* (in Riley's collection).

This habit is almost continuous with the fourth.

IV. *Larvae living in decaying vegetable or animal matter; in heaps of turf; in soft mud containing vegetable matter; in manure or foul excrement; even reported to have been passed from the human alimentary canal; in putrid stagnant water; or even in waternig troughs, wells, etc., where the water is not conspicuously contaminated:* genera, *Platychirus, Eristalis, Helophilus, Criorhina, Syritta, Orthoneura, Chrysogaster, Xanthogramma, Sericomyia, Rhingia.*

It is possible that this group might be considered as derived from its aquatic members, thru a stage in which they lived within the stems of aquatic plants; but the line of evolution suggested above is the more probable since it leads gradually to the aquatic forms which are most specialized structurally.

The question arises whether this group is a unit, structurally. Some of the members are certainly "rat-tailed." But, according to Williston, *Platychirus* has this habit and the larvae of *Platychirus* spp. are structurally of the same form as the aphidophagous species.

Groups II to IV clearly represent one, more or less continous line of evolution from the primitive phytophagous habit. Another line of specialization from the same original habitat is shown by those members of the group which have taken up the predaceous habit.

V. (A) *Larvae predaceous on soft-bodied insects living in colonies, especially plant-lice (Aphididae); but also feeding on nymphs of Jassidae, Aleyrodidae and Membracidae; on adults of Musca domestica and Chortophila pusilla; and even on larvae of other species of Syrphidae: genera, Baccha, Sphaerophoria, Pipiza, Paragus, Didea, Allograpta, Melanostoma, Syrphus and Catabomba. Paragus and Allograpta* are, I believe, added to this list for the first time, by the present studies. (See Part II, pp. 53, 54, 58.)

It seems liekly that the usual and preferable food of these species is *Aphids*, and that these other cases are largely exceptional and due to the absence of their accustomed food.

An interesting specialization of this habit, which so far as I know, has not been previously reported, in which the aphidophagous larvae live, not on the exposed surface of the host-plant but enclosed in galls, makes a sub-division of this group.

V. (B) *Larvae predaceous on the gall-making aphids, Pemphigus* and *Colopha and living within their galls; Syrphus xanthostomus* and another species, at the time of this writing undetermined.

When I had studied these larvae for a little time and noted their sluggishness I was struck with the probability that they were on the road to degeneration and possibly to true parasitism. In view of this conviction it was with much satisfaction that I noted the report of larval habits which I embrace in the third sub-division of this group.

V. (C) *Larvae said to have been bred from pupae of species of Plusia* (Ento. Month. Mag. XXXIV, 244.): *Lasiophthicus (Scaeva, Catabomba) pyrastri*.

If this report be authentic the larval habits of *Syrphidae* will take on additional interest as presenting a most instructive and perfect series, leading from free-living, phytophagous forms thru facultative and obligate predatism on individuals (or parasitism on the colony) to a condition of true internal parasitism on the individual. Aldrich (Catalog N. A. Diptera, p. 363) considers this an error and states that he has reared the species from larvae feeding on the grain aphis, *Siphonophora avenae*. The original article by E. N. Bloomfield is as follows "Last Autumn I received from a friend, a cripple specimen of *Catabomba pyrastri*, L. which he had bred from a pupa of *Plusia iota;* and this summer he sent me from Southwold, several larvae (most probably *Plusia gamma*), asking if I could tell him what they were. Two or three at once spun up, and became pupae, and to my surprise in about a fortnight two specimens of *C. pyrastri* were disclosed; the empty pupae cases giving indubitable proofs that they had proceeded from them."

I have a puparium of this species from California from which it can be seen that the larva is essentially similar to aphidophagous larvae.

VI. *Larvae living in the nest of colonial insects, chiefly Hymenoptera*:

(A) *Of the large Aculeate Hymenoptera (Bombus, Vespa):* genus *Volucella*.

These larvae were formerly reported as parasitic on the immature Hymenoptera but it now seems certain that their relation is rather that of scavengers. (See pp. 37-38) (Verrall makes a second division here of those larvae living in the nests of smaller Aculeate Hymenoptera. He states that he has no evidence to support this group but strongly suspects *Eumerus* and *Paragus*. As the present studies have shown that this suspicion is unfounded so far as *Paragus* is concerned the group may be omitted, pending definite evidence.)

(B) *Of ants (Formica, etc.) primarily, but also of termites and wasps;* genus *Microdon*.

Adlerz believed that the larvae of *M. mutabilis* feed on the moist pine wood thru which the galleries run. Wheeler, however, found that the young larvae shrivel and die when removed from the ants; which may indicate that their food supply is inseparably connected with the ants. Wheeler, indeed, believed "that it is the minute pellets of food, which after their moisture has been extracted, are ejected from the hypopharyngeal pockets of the worker ants. These pellets are scattered

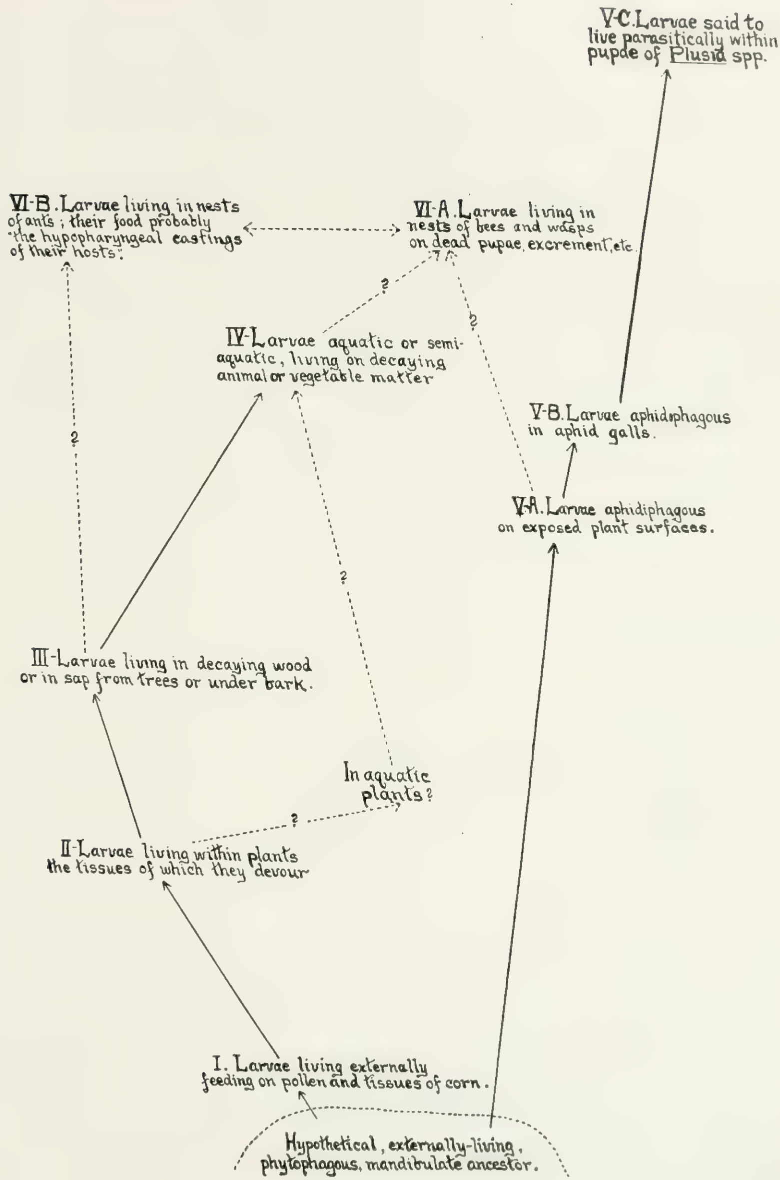


Fig. C. Table of larval habits

about the nest, especially about the superficial galleries and though hard and dry, must contain considerable nutriment. They are probably eaten not only by the *Microdon* larvae but also by many other Synoeketes."

It seems possible that this habit might have been derived in several ways. (See Fig. C.) On page 37 the idea is suggested that it might have arisen from a former habit of preying on the immature of the nests, and, if so, would be related to the aphidophagous group. The question arises whether there might be any significance in the fact that the ants are so constantly associated with aphids and so, incidentally, with the aphidophagous Syrphid larvae. This might have afforded the original opportunity for the entrance of Syrphid larvae to the ant-nest.

On the other hand it seems probable that this group may have been derived from the non-rat-tailed portion of Group IV. That is, from living on decaying vegetable and animal matter, the larvae may have changed to eating waste materials in the nests of Hymenoptera. There would be an especially natural step from Group III in the case of *Microdon*, if these larvae are found to live on the wood in any case. And it will be remembered that Adlerz from observations in Sweden concluded whether rightly or not that the larvae live on the moist and tender wood forming the walls of the ant galleries in pine stumps, although they were also found in burrows in the dry bark.

## BIOLOGICAL AND ECOLOGICAL RELATIONS AND ECONOMIC IMPORTANCE OF THE LARVAE

According to the above outline of larval habits the following are the principal biologic, ecologic and economic relations which would arise:

(1) To the insects (chiefly aphids) on which certain species prey.
(2) To the plants on which their prey is feeding, and on which they are consequently found.
(3) To the other insects which are concerned in such associations as aphid colonies and aphid galls.
(4) To their own (Hymenopterous) parasites.
(5) To plants on which certain larvae feed.
(6) To plants within the tissues of which certain larvae live.
(7) As scavengers.
(8) To such colonial insects as ants and bumblebees in the nests of which certain species live.
(9) To the predaceous enemies of both the terrestrial and aquatic forms.
(10) If the report be true, to those insects on which the larvae live as internal parasites.

(1) This first relation is in the nature of a close predatism on small insects, chiefly colonial *Homoptera* such as *Aphididae* and to some extent *Jassidae*, *Aleyrodidae* and *Membracidae*. It may also in some cases be considered obligate parasitism on the colonies. These forms are dependent on one or another kind of small, soft-bodied insect for their food.

My own studies have determined eight species of *Syrphidae* with the aphidophagous habit in the State. The larger number of these are very common. Some as *Didea fasciata* and *Syrphus xanthostomus*, are appar-

ently very closely restricted to one species of prey. Others, notably *Syrphus americanus*, *Sphaeropnoria cylindrica* and *Allograpta obliqua* are found on a variety of plants preying upon at least several species of aphids or other insects, even attacking larvae of other species of *Syrphidae*. By the species which I have studied, perhaps the greatest benefit is being wrought by the destruction of vast numbers of cabbage aphis *(Aphis brassicae)*, although that arising from the destruction of such insects as the European Grain Aphis, *(Siphocoryne avenae) Longistigma*, *Pemphigus*, *Colopha*, etc., is not by any means to be despised.

They kill the individual at once; but the colony may exist for a considerable time, replacing those lost or even increasing its number by reproduction. Sometimes the colony is entirely exterminated by the ravages of the Syrphidae. There seems to be a sufficient margin between the amount of food which the larva must have to successfully accomplish pupation, and the larger amount which may be taken and stored as surplus fat, to make the extermination of the host-colony possible in some cases, without the loss of the Syrphidae. Theoretically under these conditions the complete extermination of aphids might result.

Several larvae of one species and frequently two or three species are often to be found in a single aphid colony. Hardly one colony in five will be examined which does not have in its midst one or more larvae.

"In order to determine something of the capacity of these insects for devouring plant lice and hence their degree of economic importance, I tried feeding the larvae of *Syrphus americanus* on cabbage aphids (*Aphis brassicae* Linn.) The aphids were touched to the mouth of a larva which had not been kept from food. A four-day-old larva devoured the first aphid in 4.5 minutes, a second, third, fourth, and fifth, smaller than the first, in 2, 1, 1, and 0.5 minutes respectively. The sixth, a larger one, was retained for 3.25 minutes. These were very thoroughly eaten, all the viscera and body fluids being picked and sucked out. After this the lice tendered were not eaten so closely, but killed, a seventh in 2 minutes, an eight in 1.75 minutes, and a ninth in 1.5 minutes. On another occasion the same test was made with an older larva which devoured a dozen or two before my patience became exhausted. The tests were sufficient to establish the voraciousness of the appetites of these larvae.

"It is, of course, not probable that any larva would ever normally devour aphids so rapidly. Yet when plenty are at hand the number eaten by a larva during its life of eight days to two weeks or more must be very considerable. It should be kept in mind also that it is not the actual individuals eaten, alone, that determines the amount of benefit from

these insects; but the fact that in this way the production of enormous numbers of aphids is prevented. If, as Reaumour has calculated, and others have substantiated, one aphid may be the progenitor of over 5,000,000,000 individuals during her existence of a month or six weeks, we can see at once the important benefit that must arise from the destruction of one or two of these aphids early in the establishment of the colony. It is a fact that the eggs of Syrphidae are often deposited on the host-plant very early or even in anticipation of the arrival of the aphids."*

Assuming an equally voracious appetite, or anything like it, for the hundreds of larvae of this and other species with the same habit to be found on any ordinary farm, it is easy to see that here we have a very important check for the enormous rate of reproduction among plant-lice.

(2) The aphidophagous larvae of *Syrphidae* doubtless often save the life of the plants on which their prey lives. Aphids with their enormous rate of reproduction can easily cause the death of their host-plants, especially if infection is begun early. The Syrphids, if they do not exterminate the aphid colony, often check them sufficiently to allow the host-plant to continue growth to maturity.

A nice balance must exist here between these three organisms. If the Syrphids are to mature, a sufficient number of aphids must be produced. But if too many aphids are produced, the host-plant may be killed, the aphids, and in turn the Syrphids, exterminated or forced to migrate to another plant. It seems possible that the habit of the adults of aphidophagous species of scattering their eggs, may be of importance here, in that too many Syrphids are kept from preying on a single aphid colony, in which case the available food would be exhausted before any of them reached maturity.

In many cases there must also be a nice adaption of the life-cycle of the Syrphid to the length of the life of the aphid colony. Many aphids spend only a certain part of the year on one host-plant and then migrate by certain individuals to other plants. Migration of the larvae to any distance is out of the question, and apparently in some cases natural selection has worked out the proper length of life of the larval stage to meet these requirements.

The life-cycle must be begun at the proper time on the right hosts as well. Eggs for the first spring generation of *Syrphus americanus* are deposited, among other places, on leaves and twigs of apple at blossoming time; where are already developing colonies of the European Grain Aphis. The adults are attracted about the trees, on the blossoms of which

*The Author, *Ohio Naturalist*, Volume XII, Number 5, pp. 481, 482, March 1912.

they feed, and oviposition takes place at the same time. Not so easy of explanation, however, is the deposition of eggs on sycamore trees, by *Didea fasciata*, early in autumn in anticipation of infestation by *Longistigma caryae*; or of the eggs of *Syrphus americanus* early in mid-summer on *Phragmites* which becomes very badly infested with aphids; or of the several species on cabbage before aphids are present. In these cases there are no blossoms for the attraction of the adults and the explanation must fall to some tropism not connected with the feeding habits.

It should not be overlooked that in certain cases these larvae destroy aphids on injurious or noxious weeds (docks, thistles etc). This, although apparently a detriment, may very well be considered a safeguard against too great increase of any species of Aphididae. In some cases these are plant-lice which also attack garden and field-crops. In others where this is not known to be true, a change of food-plant for the aphid, with increase in numbers, is entirely possible. Aphids in general are such injurious insects that any of their enemies may pretty safely be welcomed as friends of the agriculturist. Hymenopterous parasites destroy vast numbers, but it is the author's belief that *Syrphid* larvae are a more important enemy of these pests than are the *Hymenopterous* parasites.

(3) The complex ecological relations which must exist in any colony of aphids, and especially in the aphid-galls such as those of *Pemphigus*, are worthy of careful study.

*First*, there are in such colonies, the plant-lice which are phytophagous. *Second*, the ever present ants which derive sustenance from the secretions or excretions of the aphids. So constant is their association with the aphids that they were often of value in leading me to discover some of the more obscure colonies of the latter. Their relations with the aphids is of a friendly nature, that to the host-plant, neutral. *Third*, the larvae of *Syrphidae* are almost always present, preying on the aphids, killing large numbers of them, and sometimes exterminating the colony. These are benefactors of the host-plant. They are indirectly inimical to the ants; yet I have never observed the slightest antagonism of ants toward them. *Fourth*, Hymenopterous parasites of the aphids (especially *Chalcididae*) are rarely absent from any colony of the aphids. These are, of course, enemies of the aphids and so, indirectly, of both the ants and *Syrphidae*, and friendly to the host-plant. Probably the larvae of the *Syrphidae* devour some of the aphids which are already parasitized by the *Chalcididae*, especially those containing only eggs or young larvae of the parasite. If this does happen it makes the *Syrphidae* by so much disadvantageous to man. The aphid would, of course, be killed as effectually as it could be by the

*Hymenopteron;* but with it would also be destroyed the parasitic *Hymenopteron*, thus checking by so much the perpetuation of these valuable insects. If this happens it would also make the *Syrphidae* decidedly inimical to these *Chalcididae* and so, paradoxically, beneficial to the aphids and ants. *Fifth*, lady-bird beetles (*Coccinellidae*) are usually present in the aphid colonies, preying on the aphids. These would have practically the same relation as the larvae of *Syrphidae;* that is, hostile to the aphids and indirectly so to the ants, the *Syrphidae*, and the parasitic *Hymenoptera*, friendly to the host-plant. *Sixth*, "Aphis-lions" the larvae of "lace-winged or golden-eyed flies" (*Hemerobiidae*) are very frequent visitors to such aphid colonies, and they, too, prey on the aphids. Their relations would be the same as for the *Coccinellidae*, and in addition they could be considered hostile to the interests of those species. *Seventh*, spiders are frequently present, especially in the aphid-galls. Their exact relations were not studied but they doubtless prey on some of the insects, and they often nest in the empty pupa cases of the *Syrphidae*. *Eighth*, Lepidopterous larvae and a number of other creatures of undetermined species and uncertain relations were also taken in the *Pemphigus* galls.

(4) Hymenopterous parasites of the larvae of *Syrphidae* themselves are present. These are fully discussed under the heading of "Enemies" pp. 50, 51.

(5) Not many larvae are known to feed externally on plant-tissues. *Mesogramma polita* is the one conspicuous case and this species, while wide spread, has excited alarm by the feeding habits of its larvae in only a few cases and a few localities. Either they do not often attack corn in large numbers (their larvae probably having other food-plants) or else their attacks pass unnoticed. When the larvae are abundant, the injury is said to be very serious. They feed on the saccharine cells at the base of the leaf-sheaths, causing a wilting and browning of the leaf said to resemble the injury resulting from the attacks of chinch bugs. The larvae also eat the pollen grains in the "tassel." While pollen production in most plants, and in corn, is a lavish one and much of it could be lost without detriment, yet with great increase in numbers of the larvae it is easy to see how they might become a serious pest of this important crop, by interfering with the formation of the grain, to which fertilization is essential. Furthermore this injury might be serious and not noticed until they had done irreparable damage.

The aquatic larvae of *Helophilus latifrons* were believed by Dr. Morrey to feed on *Confervae* or *Algae*. (See pp. 70, 71.)

(6) The larvae which live in the tissues of many plants must seemingly interfere more or less with the normal functions of the plant-body. In some cases they clearly destroy the plant or advance decay, as in cacti. The economic status of the insect in such cases will depend entirely on that of the plants attacked; if it be an obnoxious weed it would result beneficially; if in bulbs such as *Narcissus*, *Amaryllis* and onion, which are extensively destroyed in Europe at times, the larvae may become very serious pests. Injury to many other plants may for all practical purposes be considered of no economic importance.

(7) In this relation the larvae must be accorded whatever degree of importance ordinarily attaches to that scattered group of animals which, by feeding upon decaying organic matter, reduce it to a condition in which it can be more readily assimilated by plants; and at the same time often help to remove materials which may be a menace to health.

Perhaps this is a suitable place to mention a report, which has so often been given on authority which ought not to be questioned, that it must seemingly be given credence. It is to the effect that the larvae of *Eristalis* spp. have been passed alive from the human alimentary canal. "Professor Riley mentioned the sending of *E. dimidiatus* in the larval state by Dr. Compton, of Indiana, who stated that they were passed from the bowels of a young woman; also the recent sending of larvae of *E. tenax* by Dr. J. A. Lintner to whom they had been sent as having been obtained under similar circumstances."—*Ins. Life*, II, 161, 162.

These larvae are very tenacious of life. Buckton relates that larvae accidently introduced thru the water of some pulp in a paper-mill, survived the pressure of beaters or rollers used in the manufacture of paper. Gradual immunity to the digestive secretions might be acquired by living in human excrement, where they are commonly found, and so, when accidentally swallowed in drinking water, the larvae would be able to withstand passage thru the stomach and intestines. Is it not possible that, gradually, larvae so introduced might take up the parasitic habit in man?

Osten Sacken has published an exhaustive study dealing with the ancient superstitions about the spontaneous production and artificial breeding of bees, from the carcasses of oxen. He believes that the oxen-born bees, *Bugonia* of the Ancients, were the flies, *Eristalis tenax*, and that the superstitions arose because of the occasional breeding of these flies in decaying carcasses and their resemblance to bees.

(8) The relation of the larvae of *Volucella* and *Microdon* to the *Hymenoptera* in whose nests they live, has been rather fully discussed

above (See pp. 37-40). I would simply add here the following note from Wheeler, *Psyche*, July, 1911:

"The occurrence of such bulky and defenseless Dipteron larvae in the nests of large-eyed active ants like the *Pseudomyrmas*, which are, moreover, provided with powerful stings, is nearly as surprising as their occurrence in the nests of *Vespa*."

(9) I have no data to give on this relation. It seems however, scarcely possible that such succulent creatures as the larvae of *Syrphidae* would not be picked up by birds for food. The aquatic larvae might be attacked by predaceous animals but many of the media in which they thrive are of such an offensive nature as to repel many animals.

(10) The report on which this division is founded is cited on page 40.

## ECOLOGICAL RELATIONS AND ECONOMIC IMPORTANCE OF ADULTS

**Relations to Plants.** Adult *Syrphidae*, so far as we know, are almost all dependent upon the products, nectar and pollen, of the flowers of *Spermatophyta* for their food. In their visits to flowers for the purpose of feeding they inevitably carry about with them some of the pollen-grains to be shaken, brushed or scraped off in other flowers. In this way it is believed that various species of *Syrphidae* enter into an important relationship to many kinds of entomophilus plants. The importance of this relation will vary with the kinds of plants visited, the adaptation of the body of the fly which can carry pollen, the feeding habits of the fly, and so forth.

All of these points are deserving of much careful study but accurate data seem largely to be wanting. To the ordinary observer it would seem that *Syrphidae* visit all sorts of melliferous flowers indiscriminately; and this is no doubt true of many of them, perhaps all. If there are any cases of particular or specific interdependence of certain plants and certain *Syrphidae*, I am not aware of it. Adults of *Mesogramma polita* feed on pollen of corn (Ashmead). *Mesogramma polita*, *Eristalis vinetorum* and *Baccha fuscipennis* were observed by Ashmead feeding on the pollen of cotton blossoms. A number of fruit trees, while in blossom, are regularly visited by these flies in goodly numbers. I would also call attention to two articles on "Insect Pollination at Cedar Point,"* in which a dozen species of *Syrphidae* are recorded as visiting certain flowers. According to Dr. J. B. Smith† *Eristalis tenax* is said to be entirely responsible for the pollenizing of chrysanthemums in green-houses.

*The *Ohio Naturalist*, Vol. XI, No. 8, Vol. XII, No. 6.
†Econ. Ent. 2nd. Ed. p. 348.

On the bodies of these flies the vestiture is, I believe, responsible, almost exclusively, for the carrying of pollen. In this respect the species vary widely from almost bare to very densely pilose, and, as pointed out by Dr. Smith *(l. c.)*, this vestiture is often composed of spurred and branched hairs (Plate VIII, Fig. 159). In general the more thickly pilose species carry more pollen. Many of such specimens in collections have the body thickly dusted with pollen grains.

By the feeding habit of the fly I mean, whether it ordinarily visits flower after flower on the same plant, or flies more or less directly from one flower to another of the same kind on another plant. I have often noted individuals hovering about the same plant and feeding on flower after flower. If the other habit is followed in any case cross-fertilization would be much more apt to be secured.

**Relations to other Insects.** The adults enter into no particularly close relations with other insects that I know of except with those Hymenoptera which certain of them mimic. If the theory of protective mimicry has any real significance it must result in endangering by so much the mimicked form. That is, while one predaceous enemy is learning from his attack on the fortified bee to avoid prey of that appearance, another may be experiencing a successful and pleasant attack on the defenseless fly of similar appearance. Thus the value of the warning mark to both bee and fly is lessened in direct proportion to the number of defenseless individuals bearing it. (See also pp. 35-37.)

It is interesting to note the attitude of those *Hymenoptera*, in whose nests the larvae of *Microdon* and *Volucella* live, toward the adults of these flies. *Volucella*, according to reports, meets with no resistance or antagonism. The adults of *Microdon*, however, are treated with great animosity by the ants among which they spent their immature stages. The ants seize the teneral adults and lick them until the formic acid secreted by the ants kills the flies. Wheeler believes that the habit of the larvae of pupating in the superficial galleries of the nest, and of the adults of emerging at night, when ants are more or less torpid, are adaptations to making it as easy as possible for the adult flies to escape.

**Relation to other Animals.** It seems probable that the adults of many species of *Syrphidae* are a considerable source of food for insectivorous animals of all kinds, especially birds and Amphibians. The king-bird, phoebe and flicker are known to feed on *Eristalis tenax*, but I am not able to give much detailed data on this point.

## ENEMIES

(1) The common milkweed (*Asclepias* sp.) is a rather formidable enemy of adult *Syrphidae*. When the latter visit these flowers for the nectar their legs are caught by the peculiar and well known *pollinia* of this plant. In collections one finds a good many specimens with these pollinia clinging to their legs. But large numbers of the weaker-bodied *Syrphidae* become permanently entrapped by the flowers: thus not only invalidating the remarkable specialization on the part of the flower, but resulting, after long and fruitless struggle, in the death of the fly.

So common is this entrapment that I found it well worth while, when collecting, to visit these flowers. I have found as high as twenty individuals entrapped on a single head.

(2) The parasitic insects of the super-family *Ichneumonidae* constitute a very serious enemy of *Syrphidae*, at least of the aphidophagous species. I have reared the species, *Bassus laetatorius* Fabr. from larvae and pupae of *Syrphus americanus, Syrphus torvus, Paragus bicolor, Paragus tibialis, Allograpta obliqua, and Sphaerophoria cylindrica.*

It occurs most abundantly in the different hosts from midsummer to late autumn. At times fully seventy-five per cent of the individuals collected were destroyed by this parasite. I have not reared it from specimens taken previous to July.

"This parasite oviposits thru the body wall of the larvae, the eggs hatch and the larvae develop without preventing the formation of a more or less complete puparium by the host. Within the puparium the development of the larval parasite goes on at the expense of the Syrphid. The latter is entirely devoured and the parasitic larva reaches in size nearly the capacity of the puparium. Pupation then takes place and the adult emerges by gnawing a small irregular hole in the anterior end of the dipterous puparium, usually several weeks after pupation of the host. Only one parasite develops in each individual.

"The larvae when full grown measure about 4 mm. in length by 1.8 mm. in height, by 2 mm. in width. They are plump, whitish, eruciform, ovate in outline; median segments largest, humped dorsally and with the posterior end smaller than the anterior. As the orientation is the same as that of the puparium it will be seen that the full grown larva fits very nicely, in size and shape, the puparium of the host. There are 14 body-segments clearly shown; the only conspicuous appendage is the U-or V-shaped, chitinous piece in the region of the mouth. Sketches of a larva and a pupa are given as Figures 58, 59, of Plate IV.

"The adult may be easily recognized by the following description from G. C. Davis' 'A Monograph of the Tribe Bassini' (Trans. Am. Ent. Soc. XXII, p. 19, Feb. '95,) who also states that it is one of the most common and wide spread species in America: 'Female—length 6 mm. Head, thorax, base and tip of abdomen, hind tarsi, base and lower middle of hind tibiae, black; four anterior legs, posterior coxae, femora, and often tips of tibiae, tip of abdominal segment 1, whole of 2 and 3 and more or less of 4, rufous; anterior orbits, mouth, tegulae, spot in front, line

beneath, cuneiform spots on mesonotum, scutellum, post-scutellum, and band on posterior tibiae white. Male—Differs only in having the face, scape beneath and a stripe on pleura, yellowish white."—The Author, Ohio Nat. Vol. XII, No. 5, March, 1912.

The first indication of the presence of the parasite is usually a failure of the pupal envelope to inflate completely, remaining less rounded up dorsally and often with the anterior segments but little retracted ventrally. Very soon the pupa becomes darker in color than normal.

"The following are the average dimensions of 15 puparia of *Syrphus americanus* from which *Bassus lactatorius* had emerged: length 6 mm., height 2.25 mm., width 2.45 mm. Compared with the dimensions of an equal number of unparasitized individuals as given below, (p. 55) it will be seen that these are slightly smaller in all dimensions than the normal ones, with a little more difference in height than in length or width. The difference in shape is more conspicuous than these figures would indicate (See Plate IV, Fig. 56), and together with the difference in color makes them rather easy to distinguish when once the characteristics are learned."

(3) The very widespread misbelief that adult *Syrphidae* are stinging insects is rather inimical to them. As mentioned in another place (p. 35) the great majority of non-entomological people when shown *Syrphidae* express the belief that they are bees. Many of the smaller species frequently alight on the hands or face, and I have often seen them ruthlessly killed under the impression that they are "sweat bees."

Ashmead bred from the larvae of *Mesogramma polita* "two parasites, a cynipid (*Solenaspis hyalinus* Ashm.) and a chalcidid (*Encyrtus mesograptae* Ashm.)"—Ins. Life, VII, p. 326.

Other enemies concerning which I have made no particular observations are as follows:

Hubbard (1885) gives the following interesting note on Syrphus-fly enemies: "Minute Chalcid parasites prey upon the Syrphus larva, (*Baccha babista*) and issue from the puparium in numbers varying from six to eighteen, thru a number of small holes which they gnaw in its top and sides. They are from 1 mm., to 2 mm. in length, and have the dark bronze and metallic colors with hyaline and iridescent wings so common in this family (*Chalcididae*)."

## PRACTICAL MEASURES

Something might be done toward fostering and increasing the numbers of these valuable insects, if people generally, and especially those engaged in agricultural pursuits, could be brought to see that *Syrphidae* are not stinging insects; and that both as larvae and adults, they are among our most valuable animal friends.

Again, parasitized puparia may be destroyed before the parasite has had a chance to emerge. The characteristics by which these infested puparia may be recognized (see above) are such that they should be clear to anyone with a little experience.

Other methods of favoring these insects in general farm-practise as, for example, by avoiding them in spraying for aphids, etc., will suggest themselves to every agriculturist.

## Part II.

## KEY TO THE KNOWN LARVAE AND PUPAE OF SYRPHIDAE

1. Body terminating in a long, flexible, rat-tail-like appendage (often longer than the body), at the tip of which the posterior spiracles are located. (Pl. VII, Figs. 131-133); larvae aquatic or semi-aquatic ........................ 2
   Posterior breathing appendage considerably shorter than one-fourth the length of the body, rigid, larvae terrestrial .................................... 4
2. Anterior respiratory cornua of the larva has the spiracle guarded by 7-9 elongate teeth (Pl. VI, Figs. 111, 112, 113). Pupal respiratory cornua about twice as long as broad, its tubercles with 3 or 4 nodules on their tips (Pl. VI, Figs. 111b, 114, 115) .................... **Chalcomyia aerea**
   Anterior respiratory cornua of the larva has the spiracle guarded by about 20 blunt, rounded teeth (Pl. VII, Figs. 131a, 132). Pupal respiratory cornua four or five times as long as broad, its tubercles with 7-9 nodules on their tips. (Pl. VII, Figs. 145b, 147, 148) ................................ 3
3. Mature larva about 20 mm. (four-fifths inch) long, exclusive of the "rat-tail" ........................................ **Eristalis tenax**
   Main body of mature larva 13-15 mm. (slightly over one-half inch) long. (Pl. VII, Fig. 131) ........................................ **Eristalis aeneus**
4. Larvae short-oval or rounded in outline, the shape constant; convex above and with a very flat, creeping-sole ventrally, around which is a specialized marginal fringe of spines; the dorsum often nicely reticulated. (Pl. IX, Fig. 182) ........................................ **Microdon spp.**
   Larvae elongate-oval when at rest, much attenuated toward the anterior end when active ........................................................ 5
5. Larvae phytophagous; most dorsal of the three pairs of spiracles on posterior respiratory appendage rounded. (Pl. IX, Figs. 193-194) **Mesogramma polita**
   Larvae aphidophagous; most dorsal of the three pairs of spiracles on posterior respiratory appendage elongate, slit-like ............................ 6
6. Length of posterior breathing tubes at least two or three times their combined width, see also Paragus tibialis. Larvae and pupae deep green in color with two prominent, white, longitudinal stripes on the dorsum; integumental spines wanting ........................................ 7
   Posterior breathing tubes shorter, or but little longer, than their combined width, never twice as long; colors yellowish or reddish-brown ......... 8
7. Tip of posterior breathing appendage roughened, the spiracles well-elevated above the general surface and separated by spur-like elevations. The tubes very slightly divergent at the tip. (Pl. V, Figs. 66-68) **Allograpta obliqua**

Tip of posterior appendage nicely rounded off, smooth, the spiracles not elevated, and not separated by perceptible spurs. Tubes not at all divergent. (Pl. V, Figs. 72-73) ........................ **Sphaerophoria cylindrica**

8. Larvae with the entire dorsal surface covered with short spines (scarcely visible without a hand-lens), black, or sometimes light in color and then not prominent ........................................................ 9

Integument of the larvae bare except for the segmental spines...... .......13

9. Segmental spines conspicuous or raised on prominent, fleshy or spiny, conical projections easily seen by the naked eye............................10

Segmental spines not prominent and not raised on conspicuous conical projections; sometimes hard to distinguish from the integumental spines.....12

10. All of these conical projections and their spines, on the dorsal side of the body, of nearly equal size; the inter-spiracular spaces on the breathing tubes with lamellate upright plates. (Pl. I, Fig. 5)...........**Didea fasciata**

The dorsal spines (ones next the median pair) in the principal segments much reduced in size; the inter-spiracular spaces with short, spur-like processes, the median dorsal one long and prominent.......................11

11. Posterior respiratory appendage broader than long. (Pl. III, Fig. 25) ....... .................................................**Paragus bicolor**

Posterior respiratory appendage considerably longer than broad. (Pl. III, Fig. 33).............................................**Paragus tibialis**

12. Integumental spines black; inter-spiracular spaces with short, stout, black spurs. (Pl. IV, Figs. 46-49)..... .......................**Syrphus americanus**

Intergumental spines light yellow; inter spiraculer spaces with long slender hairs. (Pl. VI, Figs. 94-95)........**The Cock's-Comb-Gall Syrphus-Fly**

13. Posterior respiratory appendage longer than broad. (Pl. VI, Figs. 84-87) ..........................................**Syrphus xanthostomus**

Posterior respiratory appendage broader than long. (Pl. II, Fig. 13) ..............................................**Syrphus torvus**

## **Paragus bicolor** Fabricious

(Plate III, Figs. 21 to 30.)

For a full account of the metamorphoses and life history of this species see the *Ohio Naturalist*, Vol. XII, No. 1, pp. 397-401, Plate 1, Nov., 1911, from which article the following synopsis is written.

Larva—Length about 8 mm. Color yellowish-brown, varied with black, brick-red and drab. Integumental vestiture wanting. In segments 6-11, inclusive, the prominences on which the dorsal spines are situated are only about one-sixth as large as those prominences which bear the median, dorso-lateral, and lateral segmental spines. In the fourth and fifth segments these are all of about equal size (See Fig. 21). The mouth-parts (Fig. 23) consist of the beak-like jaws and four pairs of hooklets. Posterior respiratory appendage 0.25 to 0.4 mm. long, 0.25 to 0.3 mm. broad. Spiracles well elevated, noticeably curved in their extent. Inter-spiracular spines inconspicuous, dorsal spiracular one large, spoon-shaped, broad dorso-ventrally, narrower from side to side, concave laterad. Eggs, larva and pupae taken from curled dock,

(*Rumex crispus* L.) broad leaf dock, (*Rumex obtusifolius* L.) common burdock, (*Arctium minus* Schk.) and on thistle (*Carduus* sp.). The larvae prey upon *Aphis rumicis* and other aphids which commonly cluster on the flower spikes, tender stems, or on the under side of the large leaves of the above plants.

Puparium—Approximate dimensions: length 5.3 mm., height 2.2 mm., width 2.4 mm. The long, segmental spines, contrasted with the short dorsals or their apparent absence on the principal segments, and the short, posterior respiratory appendage with its prominent spoon-shaped spurs at the end, dorsally, should serve easily to distinguish the species in this stage. Duration in pupal stage from five to fifteen days, passed on the host-plant of the larva, among the flower spikes, on leaves, or in leaf axils.

Adult—Length 5.6 mm. A blackish species usually with much red on the abdomen. The pile of the eyes mostly grouped in two vertical stripes, separated by a distinct vertical glabrous stripe (Figs. 29-30). Face in the male wholly pure, light, sulphury yellow. Front of female narrowed above (Fig. 30). Thorax in front with two whitish, pollinose stripes.

## **Paragus tibialis** Fallen

(Plate III, Figs. 31-38.)

See the *Ohio Naturalist*, Vol. XII, No. 1, pp. 401-404, Nov., 1911.

Larva—Length about 7.5 mm. Color light yellowish-brown with some darker markings. Segmental prominences and spines smaller than in larva of *P. bicolor*, the dorsal ones in segments 6.11 less reduced proportionately, being about one-third as large as the median and dorso-lateral ones.

The most convenient means for separation of the two species in the larval stage is in the length of the posterior breathing appendage. This in *P. tibialis* ranges from about 0.4 to 0.65 or 0.7 mm. with an average of about 0.5 mm. as compared with *P. bicolor* where the length is near 0.3 mm. The width at the tip is about 0.25 to 0.3 mm. as in *P. bicolor*. The appendage besides being distinctly longer is somewhat more bifurcate at the tip in *P. tibialis* and the general surface is slightly more depressed, between the spiracular elevations. The dorsal spiracular spine is also noticeably longer. This will be made clearer by reference to Figs. 25, 26, 33 and 34.

Larvae and pupae were taken from burdock (*Arctium minus*) preying on an unidentified aphid.

Puparium—Approximate dimensions. Length 4.3 mm. width 1.8 mm. height 1.75 mm. The puparium is strongly attenuated posteriorly to the respiratory appendage both by depression and compression. The characters of the posterior respiratory appendage and of the segmental spines remain essentially as in the larva. Duration in the pupal stage 5.11 days.

Adult—A small black species 3-5 mm. long, sometimes with reddish on the abdomen. A median black band on the face of both male and female. The pile of eyes not massed in two vertical stripes. Front of female not much narrowed above, (Fig. 38). No yellow on the scutellum.

## **Syrphus americanus** Weidemann

(Plate IV, Figs. 41-57.)

See the *Ohio Naturalist*, Vol. XII, No. 5, pp. 477-488, March, 1912.

Egg—Length about 0.9 mm., diameter about 0.3 mm., white. Taken on apple, *Phragmites*, black willow and *Rumex* sp., May, June and July, 35 to 45 eggs deposited by each female in captivity. Duration in egg stage, indoors, 55 to 60 hours.

Larva—When first hatched, very hairy in appearance. When mature, about 11 mm. long, slender, prominently wrinkled. General color yellowish or salmon-brown, marked with black and white or yellowish-white. Integument covered with short, close-set black spines, almost microscopic. Segmental bristles not conspicuous. Posterior breathing appendage short (0.2 to 0.25 mm. in length) and about twice as broad, emarginate for half its length; dorsal spiracular spines moderately long, sharply conical with a very small, lateral, sub-basal spur. The spiracles irregularly and considerably curved, about 0.25 mm. long, the median one on each side nearer to the ventral than to the dorsal one. Mouth parts with three pairs of hooklets, the jaws rather short.

Larvae were taken on cabbage and other *Cruciferae*, feeding on *Aphis brassicae*, in colonies of aphids on *Phragmites*, preying on the European Grain Aphid (*Siphocoryne avenae*) on apple, on *Aphis rumieis* on *Rumex* spp., and among colonies of *Melanoxanthus salicti* on black willow.

Puparium—Length about 6.5 mm., height 2.5 mm., width 2.6 mm., not strongly elevated posteriorly. Integumental spines rather prominent, color brownish. Duration in pupal stage (indoors) 48 hours to 8 days.

Adult—Length 8-10 mm. Face with brown stripe in middle not reaching antennae. Cheeks blackish, separated from mouth by a narrow yellow border. The yellow abdominal bands separated from the margin by a narrow black interval.

**Syrphus sp.**—The larvae described below were, when taken, supposed to be, without doubt, distinct from the others I had reared. But when the adults emerged they were found to come within the limits of *Syrphus americanus* Weidemann as described by Osten Sacken. It has not been possible up to the present time to determine whether both kinds of larvae and pupae can be secured experimentally from the same strain; nor have I been able to find a satisfactory basis for the specific separation of the adults although they appear on the whole somewhat distinct from the ones I have reared from *Aphis brassicae*, etc., as described under the preceding species. The following descriptions and notes are therefore given on what may prove to be a distinct species, showing possible convergence of imaginal characters toward *S. americanus;* or else an interesting and rather striking larval variety of the former species.

Larva—Length 11 to 20 mm., width 2.75 to 5 mm., height 2.5 to 3.5 mm. The largest and most beautiful of the Syrphidae that I have seen. The shape and appendages are suggestive of *S. americanus:* a long, comparatively slender larva tapering nicely in front, with the entire dorsum beset with short microscopic hairs. These integumental hairs seem somewhat smaller than those in *S. americanus* and also rather

lighter in color requiring considerable magnification to make them visible. The segmental bristles are short, somewhat dusky but not prominent, about equal in size.

A comparison of the characteristics of the posterior breathing appendages in the two kinds of larvae failed to reveal anything notably different. Perhaps the principal disagreement between the larvae, besides the discrepancy in size, is in color.

While the larvae from cabbage, *Phragmites* etc. were all pale brown marked with white and black, these may be described as follows: a third of the width on each side the larva is colored a beautiful deep green. In the middle of each segment from 6 to 10 is a branched clump of thread-like, fatty material, colored a delicate pink, in front of which may be a whitish transverse bar. Between these pinkish masses stretch, on the median line, the six pulsating divisions of the dorsal blood vessel, black in color. These are limited laterally by broad longitudinal stripes of light brown or salmon-colored visceral matter, more or less interrupted by lateral pockets from the blood vessel, which are, however, not as conspicuous as those in the previous species.

Three grown and two younger larvae were taken near Lakeville, Ohio, in Wayne County, June 16 and 17, and placed in confinement. They were abundant at Castalia, Ohio, June 29; and were also taken at Sandusky, Ohio, a little later, and at Columbus. They were feeding among *Aphis rumicis* on curled dock (*Rumex crispus*) and on burdock (*Arctium minus*); on the former host-plant curled about the flower spike, on the latter chiefly on the under side of the broad outer leaves. In the case of *Rumex crispus* the colors of the flower spike were remarkably well mimicked by those of the larva. (See Part I, pp. 27, 28.)

Pupa—Dimensions, average of 6: Length 6.3 mm , width 3.1 mm., height 2.93 mm A comparatively short puparium, broad and high; the posterior elevation strong, not quite equal to the anterior.

If the shape of the puparium has any specific significance (and so far as I have observed it has been fairly constant within specific limits,) it would seem that this form ought to be separated from *S. americanus*. The pupa is much broader and higher. In *S. americanus* for the puparia measured, the ratio of length to height is 2.6 : 1; of length to width 2.5 : 1; while in the present form it was as low as 2.15: 1 for length to height; and 2.03 : 1 for width to height.

Three pupae formed from the specimens above, June 21, the adults emerging July 1. Another pupated June 25, and the adult emerged July 4. Other larvae taken from Burdock, (*Arctium minus*) August 10, pupated the following day and the adults emerged August 17. The duration in the pupal stage was thus found to vary from 6 to 10 days in captivity.

Adult—The few variations from the more typical *Syrphus americanus* do not seem to be of specific value. The following might be noted: Larger specimens, length about 10 mm. Front of female with an inverted V-shaped black stripe, its sides longer, parallel above; the cheeks grayish.

The yellow abdominal bands may be a little wider, the second one with angular projections in the middle, in front and behind. Hind femora in the female blackish brown on the proximal half.

### **Syrphus torvus** Osten Sacken

(Plate II, Figs. 9-16.)

See the *Ohio Naturalist*, Vol. XI, No. 7, pp. 341-344, May, 1911; also *N. J. Ag. Col. Ex. Sta. Bull.* 72, pp. 11-14, 1890, "Plant-lice and how to Deal with Them," J. B. Smith.

Larva—Length 10-12 mm., width 3-4 mm. Color brown-pink, mid-dorsal blood vessel rather prominent, no integumental vestiture except the light colored segmental spines. (From the figure given by Dr. Smith (*l. c.*) and his description,—larva "with a very rough skin, beset with minute bristly little hairs." I take it that he refers to a general covering of what I have called integumental spines, and not to the twelve segmental bristles of each segment; and if so, my observations do not agree with his.) Spiracular slits longer and narrower than in *Didea fasciata*. Inter-spiracular projections not prominent. Lateral mouth-hooklets present. Abundant among *Aphis brassicae* on cabbage in Autumn. Also found preying on *Longistigma caryae*.

Puparium—Length 8 to 8.25 mm., width 3.5 to 4.3 mm., height 3.75 to 4 mm. Testaceous—brown, smooth.

Adult—Length 10 to 12.5 mm. Gray spot on the cheek. Eyes pubescent. First abdominal band interrupted, all attaining the lateral margin.

### **Syrphus xanthostomus** Williston

(Plate VI, Figs. 81-87.)

See the *Ohio Naturalist* Vol. XIII, No. 5, pp. 81-83, March 1913.

Larva—Length about 10 mm., width 3.75 to 4 mm. Fat, thick, grub-like, sluggish larvae, strongly arched, dorsally; wrinkling prominent. Color very pale pinkish-yellow, dorsal blood vessel not conspicuous. Skin bare except for the short, light colored, segmental bristles. Jaws unusually short. Posterior repsiratory appendage a fourth longer than broad, inter-spiracular spine short, blunt, spur-like, rather prominent. Dorsal spiracular spine short, compressed, its breadth about equal to diameter of approximate circular plate.

Larvae were found full grown at Cedar Point, July 7, 1911. They were taken on poplar or American aspen (*Populus tremuloides* Mx.) in the well known galls of *Pemphigus vagabundus* Walsh, on which they were feeding. Probably each larva is dependent for its food supply on the aphids within the single gall which it inhabits.

Puparium—Length 7.2 mm., height 3.5 mm., width 3.8 mm., exceptionly inflated dorsally, posterior inflation equal to that anteriorly. Duration in pupal stage, seven to eight days.

Adult—Length 11 to 12 mm. Lateral margins of thorax distinctly yellowish pollinose, scutellum wholly yellow. The three principal bands of the abdomen broader than the black interval, attaining the lateral margins in nearly their full width.

## **Didea fasciata** Loew

(Plate I, Figs. 1-8 and Plate VI, Fig. 17.)

See the *Ohio Naturalist* Vol. XI, No. 7, pp. 337-341, May 1911, and Vol. XIII, No. 5, p. 90, March 1913.

Egg—Length 1.3 to 1.7 mm., diameter 0.4 to 0.6 mm. Sculpturing of the chorion very characteristic—the principal bodies of it have a secondary reticulate ornamentation of their own (Plate VI, Fig. 17). Found on sycamores, September 29 to October 27, glued to the bark on the under side of horizontal limbs.

Young larvae similar to mature ones. Mature larva—length 12 to 15 mm., width 5 to 6 mm., testaceous brown. Segmental bristles crown the summits of prominent, conical elevations beset with the short radiating black bristles which cover the integument generally. Inter-spiracular ornamentation consists of a small number of upright, irregular, lamellae-like ridges. Dorsal blood vessel not prominent.

Found preying only upon *Longistigma caryae* on sycamore and basswood.

Pupa—Length 9.5 to 10 mm., width 4.5 to 5 mm., height about 4.5 mm. Color Roman sepia. The shining brown color, vestiture as described for the larva, and the characteristics of the posterior respiratory appendage, should easily distinguish this species. Duration in pupal stage (indoors) 20 days.

Adult—Length 11 to 15 mm. Third vein of wing deeply curved near the middle into the first posterior cell. First yellow abdominal cross-band interrupted, reaching the margin. Second and third bands not reaching the margin.

## **Allograpta obliqua** (Say)

(Plate V, Fig. 61-70.)

See the *Ohio Naturalist* Vol. XII, No. 8, pp. 533-537, June 1912.

Egg—Elongate oviod. Length about 0.8 mm., diameter 0.3 mm., (Figs. 61-62). Color chalk-white, with microscopic sculpturing. Oviposition noted the middle of May and the middle of June on persimmon (*Diospyros virginiana L.*) and on curled dock (*Rumex crispus L.*). Nearly 100 eggs deposited by a female. Duration in egg stage (indoors) 2.5 to 3.5 days.

Mature larva—Length about 8 mm., width about 2 mm. Color leaf-green with two prominent, longtitudinal, white stripes dorsally. No body vestiture, except the segmental bristles. Outer pair of mouth-hooklets present. Posterior respiratory appendage prominent, 0.5 mm. long, 0.125 mm. broad. Inter-spiracular spurs short, continued down the sides of the tube as more or less evident ridges.

Predaceous on a species of *Aleyrodidae* on persimmon in June; on *Aphis brassicae* September, October; on *Aphis rumicis* on *Rumex crispus* in June.

Puparium—Length 5.25 mm., width 2.5 mm., height 2.3 mm. Posterior elevation very gradual. Color changes from that of the larva to that of the adult as the metamorphosis goes on within. Duration in pupal stage (indoors) 3.5 to 5.5 days in June, as long as 10 days in Autumn. Found on parts of the larval host-plant, June to October.

Adult—Length 6 to 7 mm. This species may be recognized by the generic characters—yellow thoracic stripes and abdominal cross-bands, and on the fourth and fifth segments, four longitudinal, oblique, yellow stripes or spots; together with the yellow face lacking a complete median stripe.

## **Sphaerophoria cylindrica** (Say)

(Plate V, Figs. 71-78.)

The *Ohio Naturalist*, Vol. XII, No. 8. pp. 538-541, June, 1912.

Egg—Length 0.9 mm., diameter 0.3 mm. Elongate oval. Females taken in May deposited several dozen, apparently infertile eggs.

Larva—Length 9 to 10 mm., width 2.25 mm. Color pea-green with two, dorsa longitudinal, white stripes; heart-line only moderately conspicuous. No vestiture except segmental spines. Outer pair of mouth-hooklets present. Larvae of this species can be very certainly separated from those of *Allograpta obliqua* by differences in the posterior respiratory appendages.

In *Sphaerophoria* the end of the posterior respiratory appendage is very nicely and evenly rounded off; the two tubes slightly emarginate but not at all divergent at the tip; and all trace of inter-spiracular spines or projections lacking. With the aid of a good hand-lens and Figures 66 and 68 compared with 72 and 73, one should have no trouble in separating these two species in the larval stage.

Taken among *Aphis brassicae* in June and September; on *Rumex crispus* in June; and on *Carduus* sp. (Among *Aphis* sp.) in August.

Puparium—Length 5.3 mm., height 2.05 mm., width 2.1 mm. Less strongly elevated posteriorly then in *Allograpta obliqua* from which it can be separated on characters of the posterior respiratory appendage. Pupation observed on host-plants in late June, September and October. Duration of pupal stage (indoors) 5 to 7 days.

Adult—Length 6 to 8 mm. Lateral stripe on thorax reaches only to the suture. Spots on pleurae as shown in Fig. 71 Plate V. Abdomen slender with yellow cross-bands. Legs including coxae, yellow.

## **The cock's-comb-gall syrphus-fly**

(Species undetermined)

(Plate VI, Figs. 91-95.)

Although I was unable to get these larvae to pupate, their habits are so interesting that the following description is given, though the species is as yet unknown to me.

Larva—Length 8 to 10 mm., width 2.5 to 3 mm., height 1.5 to 2 mm., distinctly flattened ventrally, moderately convex above, elongate ovoid in outline. The dorso-lateral carinae are rather prominent as are also the transverse folds of the integument. The posterior respiratory appendages are prominent, 0.6 mm. long, 0.4 mm. wide. The color of the larva is pink vinaceous, deep-flesh, or purplish, darker beneath.

The dorsum is covered with comparatively large, though almost invisible spines of the same color as the integument. The segmental bristles in this case are very inconspicuous, only about three times as long as the integumental spines. The color and vestiture are always very much obscured by a dusting of fine, white, powdery or cottony material which the larvae derive from the gall-making aphides among which they feed. This too, is partly responsible for the unusual opaqueness of the integument or the fact that none of the viscera show clearly. A slight darkening of the posterior median line indicates the dorsal blood-vessel, but its outlines or pulsation cannot be discerned.

The antennae are unusual in having the two smaller segments, which lie side by side on a fleshy elevation and are usually rounded, considerably elongated in a vertical direction, contiguous medially.

The mouth-parts are strong, the V of the jaws short, with a long slender median, terminal projection; the spurs at the base of the lower jaw short. There are three pairs of mouth-hooklets; two pairs close beside the jaws, the dorsal ones short triangular, the ventral pair elongate; and a lateral or outer pair heavy, unequally bidentate, recurved. The anterior spiracles are moderately elevated on a sub-conical prominence and are guarded by six, unequal, tooth-like lobes.

The posterior breathing appendages present the following characters: The spiracles are straight, moderately long, rather prominently raised above the general surface. Dorsal spiracular spine median to the circular plate, wanting. Inter-spiracular projections four on a side, bristle-like (in this respect differing from all the other larvae I have examined) the bristles one-half to one-third as long as the spiracles. Surface between the spiracular elevations free from warts or ridges, depressed between the outer ends of the spiracles. The sides of the tubes are finely and unevenly echinulate; a ring-like constriction about mid-length beyond which the diameter is slightly less to the tips, where the spiracles expand somewhat.

These larvae were abundant, and apparently nearly full grown, on June 17, near Lakeville, in Wayne Co., Ohio, when the material was collected. They were found living in the galls on a species of Elm (*Ulmus*) which are familiarly known from their shape as "Cock's-Comb-Galls," preying upon the gall producing aphids, *Colopha ulmicola* which line the inner walls of the gall chambers.

These galls are formed on the upper surface of the leaves, opening beneath thru a slit-like aperature, several to many obliquely arranged at the sides of the mid-vein. They are commonly an inch in length by a fourth or more in width, incompletely divided into a series of about half a dozen chambers. The upper surface of the gall is dentate and gives to the gall its name.

Sometimes two or three of the larvae will be found in one gall, a space four or five times the volume of their own bodies. These galls are rigid, the edges of the slit closely apposed and offering considerable resistance to being opened. It therefore seems very doubtful to me if a larva ordinarily ever leaves the particular gall in which it begins its growth.

A few eggs were found on the under surface of the affected leaves. From such a position the larvae could easily crawl into the galls while still of small size as when just hatched.

The full-grown larvae in confinement show a negative photo-tropism.

Enclosed closely in the gall they enjoy excellent protection and have for the most part an abundance of food at hand. I discovered no enemies.

Seemingly they are paying the usual penalty for sedentary life They are very sluggish. After seeking some dark protected place in the jar which confined them they scarcely move unless disturbed. These particular larvae were removed from the locality where similar food was not available; and, although offered numerous other kinds of aphids, they refused to eat and all died before pupating. The result of their habit of life seems, therefore, to be a close restriction to one species of prey; and probably they are confined ordinarily to the aphids of a single gall. Their sluggishness would also suggest a possible further degeneration. (See pp. 39, 40.)

## **Eristalis aeneus** (Fabricius)

(Plate VII, Figs. 131-141.)

See the *Ohio Naturalist*, Vol. XIII, No. 5, pp. 84-89, March, 1913

LARVA—Similar to, but smaller that the well-known, "rat-tailed" larva of *E. tenax* 13 to 15 mm. long, 3 to 4 mm. broad, 2 to 3 mm. high. Posterior respiratory appendage varying from 0.5 to 0.25 mm. in diameter, extensile, 3-segmented, its length seldom less than 5 mm., frequently 15 to 30 mm., occasionally as much as 100 mm. or about 4 inches. Ornamented at the tip with four pairs of delicate, feather-like appendages, presumably homologous with the inter-spiracular ornaments of aphidophagous species. Color dirty, grayish-brown. Integument translucent, flexible, bearing integumental vestiture and double segmental hairs. There are seven pairs of pro-legs.

Collected in the very putrid watery material of the evaporating vats at the Columbus Sewage-Disposal Plant in September, undoubtedly feeding on the decaying, sewage particles.

Puparium—Length 8 to 10 mm., height 3 to 4.5 mm., width 3.5 to 4.5 mm. Shape that of the larva, considerably shortened, and somewhat inflated dorsally. Pupal respiratory cornua located a short distance posterior to anterior respiratory cornua of the larva, on dorsal side of the body; about 2 mm. in length, 0.25 mm. in diameter. These cornua are provided on their distal three-fourths with several hundred short rounded tubercles each ornamented on the tip with 8 or 9 radial elevations. Internally the cornua lead by tracheae to the prothoracic segment of the developing nymph. Larval respiratory cornua rigid at a length of 0.75 mm.

Pupae were found attached to an iron railing surmounting the walls of the sewage vats in mid-September, emerging as adults 10 days later.

Adult—Length 8 to 10.5 mm. Wholly dark, metallic-green shining. Eyes covered with small, round spots. Thorax of female with grayish white stripes.

## GENERIC REVIEW OF BIOLOGY

**Microdon**—Larvae and pupae of this genus have been described as two or three different species of Molluses as well as listed among the Coccidae. They have been discovered in the nests of a dozen species of ants and of *Vespa crabro* in Europe as well as in the nests of termites in Madagascar and Brazil. In North America *Microdon tristis* seems to be the only species which has been reared from the larval stage. According to Wheeler, the species referred to as *M. globosus* by Packard and Lintner is *M. tristis*. This species has been taken in the U. S. with *Formica schaufussi*, *F. rufa obscuripes*, *F. difficilis var. consocians*, and *F. sanguinea aserva*. Larvae of at least three other undetermined species have been described. (See W. M. Wheeler, "Ants," pp. 383-386; Psyche, July, 1901; and Journal N. Y. Ent. Soc. Vol. 16, pp. 202-210, 1908. Also Sharp. Camb. Nat. Hist. Vol. VI, Part II, pp. 501-502.)

**Chrysotoxum**—"The metamorphoses are believed to take place in rotten wood, or in the diseased sap of trees, but very little is known about them."—Verrall, British Flies, p. 642.

**Chrysogaster**—"The larvae of two European species have been bred from the mud of a ditch."—Verrall, p. 186.

**Pipiza**—Riley in his First Mo. Rept. 121, fig. 66, and in Amer. Entom. I, 83, describes *Pipiza femoralis* Loew., under the name of "The Root-louse Syrphus Fly (Pipiza radicum n. sp.)," as an enemy of the apple-root Plant-louse (*Schizoneura lanigera*) and in his 6th Mo. Rept. as an enemy of the Grape Phylloxera (*Phylloxera vastatrix* Planchon). I quote from these papers as follows:

This "footless maggot" is about one-half an inch long, and of a dirty yellow color. It is generally found more or less covered with mud, and with the wooly matter secreted by the lice, and is not by any means easily discerned. It changes in the fall to the pupa state from which, in the following spring, there emerges the perfect fly.

"*Larva*—Dull pale flesh-color, tinged with yellow. Attenuated and somewhat depressed anteriorly, more blunt posteriorly, the anal segment being furnished with an elevated tube which is of a light polished brown at extremity. Wrinkled transversely, with a prominent fold at anterior and posterior edge of each segment. The larger segments well defined; the smaller ones less so. First segment thoroughly retractile and sufficiently translucent when extended to show the dark triple-jointed mouth. A few soft, fleshy spines of the same color as the body especially distinct on anal segments. Length when not extended 0.23 of an inch. From five specimens."

"Pupa—Dull dirty yellow. Gradually formed by the contraction of the larva, during which time the wrinkles are obliterated, at last becoming quite smooth. Length 0.18 inch." A puparium buried in moist sand twice crawled up the side of the bottle in which it was contained.

"Pipiza modesta, Loew, was reared from apple twigs infested by *Schizoneura lanigera* (Hausm)"—F. M. Webster, Canad. Ento. XXX, p. 19.

**Paragus**—Rondani about 1848 published notes to the effect that the larvae feed on aphides which occur on or near the roots of *Centaurea* and on *Sonchus*. Verrall in his work on British Flies in several places states his impression that this is not authentic and makes a special division of larval habits for those "living in the nest of smaller Aculeate Hymenoptera." He says (p. 674) "I have no evidence to support this group, but I strongly suspect *Eumerus* and *Paragus*," since "the species have a very suspicious habit of hanging about the burrows of the small *Halicti*" (p. 150).

The present studies happily clear up this doubt and settle once for all that the larvae, at least of *P. bicolor* and *P. tibialis*, are aphidophagous.

**Chilosia**—"Not much is known about the metamorphoses of any species of this genus, but some larvae have been reared from fungi and others from stems and roots of plants, which seems to show that their habits are widely divergent from the genus *Syrphus*." Verrall, British Flies, p. 207.

**Chalcomyia**—In the collection of Prof. James S. Hine is one male specimen of *C. aerea* with puparium attached which bears the label "Pupa taken under bark, Columbus, Ohio, 4-11-1902." To him I am indebted for the opportunity of here describing the puparium and for the following notes on it.

*Puparium* described from one specimen:

Length of body about 7 mm., posterior respiratory appendage, or "rat-tail" projecting that much farther, fixed in a curve. Four-fifths of its length consists of the basal segment which has a diameter of about 0 5 mm., at the base, but tapers somewhat toward the end. The middle and distal segments are each extended only about 0.75 mm., diameter 0.2 mm., or less; these are shining reddish-brown. The basal segment and the body generally are dull, dirty, grayish brown. The vestiture is obscured; but the middle segment of the respiratory tube shows transverse wrinkling, in which respect it differs from the corresponding structure of *Eristalis aeneus*.

Width of puparium 3.25 mm., height about the same. Shape ovate, the anterodorsal part which separates as the operculum, flattened, bearing on its anterior part the larval respiratory cornua; while just back of the line where the operculum separates are located the pupal respiratory cornua. (See Plate VI, Figs. 111-115.)

The anterior or larval respiratory cornua are fixed at a length of about 0.25 mm., their diameter being about 0.125 mm. The spiracles at the tip show seven to nine, somewhat elongate, teeth-like lobes as shown in Figs. 112-113 of Plate VI.

The pupal respiratory cornua (Figs. 111 b, 114) are short and thick, 0.75 mm. in length by about half as broad, clavate by the elevation of the numerous tubercles thru which I believe the spiracles open. These are about 100 in number in this species (Fig. 114). They show at their tip three or four nodules (Fig. 115), between

which are depressions radiating from the center. Between the tubercles the surface of the cornua is finely papillose. The scars of seven pairs of pro-legs and the position of the anus show on the ventral side (Fig. 111, *e and d*).

This specimen was taken from under the bark of a fallen log along the Olentangy River. The log lay quite close to the edge of the water, and the larva may have been aquatic and migrated to the log for pupation, or it may have lived in the log thru the larval stage.

**Myiolepta**—"The metamorphoses have been recorded from decaying Poplar (*Populus*) and Maple (*Acer*) trees, in which case they probably feed on the exuding sap and thereby tend to confirm their relationship to *Xylota*." Verrall, British Flies, p. 573.

**Baccha**—"The larvae feed on *Aphides* or *Coccidae*." Verrall, British Flies, p. 456.

Townsend, Jour. N. Y. Ento. Soc. V., 172 briefly describes the pupa of *Baccha clavata* as follows: "One male bred from pupa found in square of cotton at Carmen, May 24. The pupa was fastened by its anal end to the inside of the square. Length 5.67 mm. Pale greenish-yellow. Oval with a flat ventral surface, full and rounded on anterior end. A few short, hair-like filaments of integument on dorsal surface in five transverse rows, the first row being on anterior end above cephalic plate. The adult was found issued May 31."

Perkins, "Leaf-Hoppers and their Natural Enemies," Hawaii (1906) p. 177-179, reports a species of Baccha feeding upon young leaf hoppers in Queensland.

"Osten Sacken, 'Entomologische Notizen,' Stettin. Ent. Zeit. XXIII, 412 (1862), refers to earlier records of habits Baccha spp. especially Coccidivorous forms."

H. G. Hubbard (1885) describes three species of Syrphidae feeding among aphids on the orange as follows:

The Four Spotted Aphis Fly. (*Baccha babista* Walker.) The larva has a cylindrical body, greenish, with a longitudinal band of dull red on the back; the surface is covered with very short, stiff hairs, giving it a velvety appearance; each joint of the body is armed with a row of soft spines above and a pair of fleshy pro-legs below. Length, when at rest, 7.5 mm. The puparium, has the form of a cone, with one side flattened and fastened to the surface of the leaf; the large end broadly rounded; the color varies from dirty white to dull yellow, and there are more or less distinct cross-shaped markings upon the back; the spines of the larva shrink to minute prickles on the puparium. The eggs are elongate-oval, brilliant white, the surface marked with diamonds obliquely intersecting engraved lines. They are deposited by the parent fly singly upon the leaves among Plant-lice.

The Dusky-Winged Aphis Fly. (*Baccha lugens* Loew.) Scarcely less common than the preceding; the larva more leech-like, flattened and dilated behind, but with the anterior joints lengthened into a very mobile and extensible neck. The surface of

this larva is nearly smooth, without the spines or velvet hairs of the first species; in color dark, inclining to purple when not feeding, with cream colored blotches, tinged with pink. The length in repose is about 8 mm. The puparium is dull brown, gourd shaped; the anterior portion greatly inflated and behind suddenly flattened and contracted to form a sort of a handle. The egg is indistinguishable from that of *Baccha babista*.

The Ruddy Aphis-fly. (*Baccha cognata* Loew.) Larva found in company with the preceding species preying upon Aphis, sometimes upon Orange, but more frequently upon different kinds of Plant-lice found on herbaceous plants and weeds of the garden. The larva has the form and smooth surface of *B. lugens*, but is more transparent and lighter in color, yellowish-green and white predominating; more slender and smaller than either of the preceding species.

**Platychirus**—"*P. scutatus* is said to have been bred from rotten fungi." Verrall, British Flies, p. 263.

In the collection of Prof. James S. Hine are two male specimens of *P. quadratus* with the puparia attached bearing the label "Columbus, Ohio, 4-3-1902." To him I am indebted for the following notes on them and the opportunity to give the following brief description.

These specimens were taken from a cat-tail or related plant in a marshy location.

Empty *puparia* described from two specimens: Length 6. 5 to 7. 5 mm. Height 2 to 2. 5 mm. Width slightly over 2 mm. Elongate-ovoid in outline as seen from above, bulbous in front, broadest and highest well in front of the middle. Circular in outline as seen from in front. From the side Fig 101, Plate VI, the ventral line is nearly straight, the dorsal one well elevated and rounded out in front, descending gradually to within about 1.5 mm. of the posterior respiratory appendage, thence more rapidly. The posterior respiratory appendage (Figs. 102, 103) is short, not at all prominent, a half broader than long; the black spots about the spiracles rather well elevated, the appendage roundingly excavated between them, its surface smooth not marked by very prominent spines or ridges.

Color when empty very light ashy-brown. The segmental spines were invisible and so may be considered inconspicuous in this species. The anterior respiratory appendages had been pushed off with the operculum which was not preserved.

**Melanostoma**—"The larvae were naturally supposed to be aphidophagous; Giard in 1896 reared a number of larvae of *M. mellinum* which attacked and killed numerous specimens of *Musca domestica* and *Chortophila pusilla* on the umbels of the common carrot (*Daucus carota*); he adds however, that there were no aphids on these plants of *Daucus*, so it is possible that in default of their usual food they may have seized the next best available." Verrall, British Flies, p. 303.

**Eupeodes**—"It is very probable that De Gerts exhaustive description of the metamorphoses of his *Musca pyrastri* referred to this species (*Eupeodes volucris*); he found the larvae feeding on the aphides of pine trees, but in captivity they readily eat other aphides as might be expected from such a ubiquitous species." Verrall, British Flies, p. 384.

**Didea**—"Larvae probably aphidophagous, as Col. Yerbury found *D. intermedia* not uncommon on Furze (*Ulex*) bushes which were infested with an *Aphis*. The type representative of *D. fasciata* was bred, but I do not know from what." Verrall, British Flies, p. 326.

*D. fasciata* var. *fuscipes* is aphidophagous; see p. 58.

**Lasiophthicus**—"Mr. G. C. Bignell has bred *C. pyrastri* from a lrva which he found on a Rose-bush (*Rosa*); the larva was green with a purplish-white dorsal stripe, and the perfect insect emerged on June 17 after having been in pupa three weeks. He also bred it from *Aphis brassicae*, *A. pruni*, and from an *Aphis* on Knapweed (*Centaurea*)." Verrall, British Flies, p. 336. See p. 40 *ante*.

**Syrphus**—Probably all aphidophagous. See pp. 54-57.

Riley, Rept. Dept. Agr. 1889, 351, mentions the larva preying on Grain Aphis, *Siphonophora avenae*.

**Allograpta**—*A. obliqua* is aphidophagous. See pp. 58, 59.

Riley, Rept. Dept. Agr. 1889. 351, mentions the larvae feeding on *Siphonophora avenae*.

**Xanthogramma**—*X. emarginata*. Williston notes a specimen in Riley's collection labeled "found under bark of cotton tree, Fla., April 20, '74."

Verrall, British Flies p. 448 says "the larva has been reared from heaps of turf."

**Mesogramma**—In Insect Life. I, pp. 5-8, Fig. 1, and 2., p. 115, Riley and Howard report the occurrence of "The Corn-feeding Syrphus-Fly, (Mesogramma polita Say)" in New Jersey (1885) and Florida (1886). The larvae were sent in on corn with the report that they were not doing evident damage. An examination of the contents of the alimentary canal showed the presence of partly crushed pollen grains, and the larvae fed upon the pollen grains of fresh corn "tassels" offered them. In the field they clustered on the plants in the axils where the upper leaves joined the stalks, the latter half of August; remaining and increasing in size for two weeks after the corn was cut. Another patch blossoming early in September became infested at that time. Adult insects emerged September 7 to 15 from larvae taken Aug. 31 and pupating a few days later. In Florida larvae were found (May and June) feeding, not on the pollen grains, but on the leaves, the stalk, and soft discolored places in the stalk.

The whole transformation from egg to fly is completed in less than three weeks. The egg hatches in from three to four days; the larva matures in from eight to ten days and the fly appears in from eight to thirteen days.

In 1889 these larvae were reported seriously damaging corn at Cadet, Missouri in August. Here they were feeding between the base of the leaf and the stem in large numbers causing a wilting and browning of all the lower leaves, an effect "Exactly the same as that produced by the Chinch bug."

"*Egg*—The egg, according to Mr. Ashmead, is pure white, elongate-oval, with longitudinal and intersecting cross-lines or grooves, not apparent to the naked eye. It measures nearly 1 mm. in length.

"*Larva*—Average length about 7 mm. Slender, subcylindrical, tapering anteriorly, its posterior end slightly flattened. The whole body is divided by apparently 36 annulae, and its surface is closely granulated. Mandibles black. The last segment bears the two short, stout, polished, dark yellow spiracular tubes, each with three spiracles at the tip. Color pale yellowish, or more or less of the color of the pollen, with 2 medio-dorsal, slender, somewhat wavy purple lines, which start conjointly on the first segment, diverging but slightly posteriorly, and terminating on the anterior portion of the penultimate segment, which latter is marked in addition with somewhat reddish and squarish spots, arranged in transverse square.

"*Puparium*—Length 5 mm., to 7 mm. Clavate, subcylindrical, slightly curved, its anterior end thickest and rounded. The posterior end has a median carina and rather sharp lateral edges and more or less flattened ventral side. The last segment bears the two spiracular tubes with black spiracles, the upper one of which is smallest and round, whilst the two other large ones which are placed close above each other are transversely oval. Color greenish or brownish-yellow, marked often with a more or less distinct dusky median, an interrupted subdorsal, and a lateral line. The median line is generally present only along the posterior carina."

**Sphaerophoria**—*S. cylindrica* aphidophagous. See p. 59.

"Some species are known to be aphidophagous and *S. flavicauda* is in some way associated with the ordinary garden *Asparagus* and may be found rather commonly upon the flowering plants." Verrall, British Flies p. 427.

Riley, Dept. Agr. 1889, p. 351 reports the larvae of *S. cylindrica* as feeding on *Siphonophora avenae.*

**Sphegina** and **Neoascia**—Metamorphoses apparently not known.

**Rhingia**—"The metamorphoses are supposed to occur in cow-dung, and Schiner suggests that in flight and color the species mimic the reddish species of Aphodius." Verrall, British Flies, p. 478.

**Brachyopa**—"Our one British species (*bicolor*) has been bred by Leon Dufour from the flowing, ulcerous sap of an elm, and as it has been captured in England where the sap was exuding from a tree-trunk, there can hardly be any doubt about its habits." Verrall, British Flies, p. 475.

**Copestylum**—Williston, Ent. News, II, 162, notes the rearing of *Copestylum marginatum* from larvae feeding in the tissues of the common

cactus of the plains, *Opuntia missouriensis.* (See also below under *Volucella fasciata.*)

**Vloucella**—The larvae of this genus show two distinct and interesting habits. Some of them live in the nests of the large Aculeate Hymenoptera, others in cacti. The larvae of *V. inanis* have been taken in the nests of *Vespa crabro* (Sharp); *V. bombylans* from the nests of *Bombus lapidarius* and *Vespa germanica.* Verrall p. 486.

"These larvae are pallid, broad and fleshy, surrounded by numerous angular, somewhat spinose outgrowths of the body; and have behind a pair of compound stigmata in the neighborhood of which the outgrowths are somewhat larger." Sharp, Camb. Nat. Hist., Vol. VI, Part II, p. 500. (For a further discussion of this interesting habit see pp. 37, 40.)

Hubbard in Psyche, May, 1899, suppl. I, 1, gives the following note on the occurrence of larvae of *Volucella avida* in giant cactus, *Cereus giganteus*, in Arizona. "A grizzled old trunk had been chopped by somebody's axe and had on one side a cavity about as large as my hat, partly filled with black rotten material. The rotting was constantly advanced by great numbers of huge dipterous maggots (*V. avida*), etc."

*V. fasciata*: Larvae were found in the tissues of the common cactus of the plains, *Opuntia missouriensis* in Colorado. "Puparia from the joints of *O. missouriensis* disclosed two allied Syrphids, *Copestylum marginatum*, *Volucella fasciata*. The puparia were lodged deeply in cavities within the stem, evidently the feeding place of the larva. The puparia of the two species are scarcely distinguishable, both having a short, conjoined stigmatic tube and two slender anterior projections." Ent. News, II, 162.

Smith, Canad. Ento. XXIII, 242 gives these notes on *V. fasciata*. A lot of prickly pear cactus was examined and Lepidopterous larvae removed from it. "A few days after a Dipterous pupa was noticed in the jar which had been left undisturbed and eventually some 8 or 10 Syrphid flies made their appearance. They could not have been parasites for all the Lepidopterous larvae were accounted for, and I can only suppose that either eggs or very small larvae were in the partly decaying flesh of the infested leaves and these were overlooked because not expected."

Buckton, "Nat. Hist. of *Eristalis tenax*," p. 84 gives the following on *V. pellucens*: "The grubs are footless, but show small false feet with minute hooks. The long spiracles at the tail end are absent. The larvae are blind. The puparium is very like that of *Eristalis* and it develops outward cornua. The case is provided with a hinged operculum which remains attached after the fly has escaped."

**Sericomyia**—The following notes on *S. borealis* are taken from a quotation in Verrall, British Flies, p. 637. "The three 'long-tails' were in a shallow pool or puddle where peat fuel had been dug out the previous year; some of the sods being too fragile for wheeling away had been tossed back into the pit, but turned upside down. It was on this decomposing mass that I found the maggots surrounded with water; their color might be called a dull gray. One thing is certain, that they pass all their stages in the course of the year as there were no pools at the place previously to 1893. The situation is damp and the pits, though filled with stagnant water, never become putrid or offensive." W. Sim, May, 1894.

**Eristalis**—These are the famous "rat-tailed" larvae which have been noted from very early times, and mention of which has been made in almost every text-book on Entomology. The present studies have dealt briefly with the life-stages of *E. tenax* and *E. aeneus*, the latter not previously recorded so far as I am aware. See p. 61. G. B. Buckton has written an extensive "Natural History of Eristalis tenax or the Drone fly." (London, 1895) which, while it treats the subject in an exhaustive manner, is apt to be indefinite about the finer details. He discusses the genus and the species *E. tenax* and *arbustorum* under the following headings: Classification, Life-History, Morphology, Physiology, Histology and Development, Distribution, and Myths, and gives a number of plates. He found the larvae abundant in ponds floating in knots of six to ten individuals with their tails tied together and buoyed up by mucilaginous masses of ova of an undetermined gnat, and gives the following notes on them: The larva of *E. tenax* has eight pairs of pro-legs, of *E. arbustorum* seven pairs. The tail is also used in helping the larva to penetrate into soft mud. They were found to be sensitive to the light of a lamp even when all rays of direct heat were shaded off; to touch especially in the region of blunt tubercles on the head; and a large number of larvae (*E. arbustorum*) were killed by a thunder storm. The puparia are buried but not deeply in mud, doubtless a protection against drought.

"The common *E. tenax* is essentially the 'Drain fly' of the whole world, as it has followed all over the world what civilization has considered its improved sanitary arrangements of drainage and it has been very interesting to watch the lines of route and the length of time it has taken to arrive at new localities (p. 674). "In October 1886 (Ent. Month. Mag. p. 97) Baron Osten-Sacken contended, and I think rightly, that this species spread thru Europe to all Asia and thence to Western North America about 1870, after which it received a check in its distribution until the

human communication from the Western States became continuous with Eastern States, where it made its appearance about 1875, after which it spread with marvellous rapidity over the Eastern States and became an abundant species by 1884. Osten-Sacken further comments upon this species not crossing from Europe to Eastern America in four centuries of intercourse but spreading by land, and then says it will be interesting to watch if it will reach distant islands such as New Zealand. It appears to have reached New Zealand two years after that, and to have become common there in one year." p. 508, Verrall, British Flies.

"*Eristalis temporalis* (*hirtus* Lw.) Reared from maggots found in ooze about the mouth of a drain at Fort Collins. Flies emerged from 4-11 to 5-3." Baker, Ent. News. VI, 174.

Larvae probably of *E. tenax* are reported as infesting a well in South Carolina in Ins. Life, III, 22. Ordinary cleaning of the well does not get rid of them, but they quickly redevelop, so that one bucket of water will frequently contain three or four.

**Tropidia**—"Metamorphoses not known." Verrall.

**Helophilus**—"Meigen states that *H. pendulus* has been bred from putrid water." Verrall, British Flies, p. 524.

Lintner, 7th N. Y. Report pp. 228 to 234 discusses the life-history of *H. latifrons* and from this the following notes are taken: The larvae of *H. latifrons* were received in 1885 from Dr. Morrey who had taken them at Nassau, N. Y. They were numerous in a water tank, July fourth, but a week later only a half dozen could be found. A week later when they floated on the surface of the water they presented the following features: The body was sub-cylindrical, narrowing somewhat anteriorly, one-half of an inch in length by one-eighth of an inch broad; beneath whitish, pale brown above, becoming darker towards the tail; the several segments showed six divisions (as wrinkles or folds) above, of which the front one is the broadest. On segments two to seven apparently (the posterior ones not being separable) are six pairs of tubercle-like feet," [Buckton states that there are seven pair of pseudopodia] "which when protruded show each a short black spine. The head bears anteriorly two brown, slender, blunt projections, so short as to be barely visible without a magnifier. The first two joints of the dark brown tail are corrugated, and measure 0.7 inch in length, with the terminal, black-tipped, extensile joint projecting from them one-fourth of an inch. They were transferred to a box of dampened sawdust into which they buried themselves for pupation the middle of July. The pupation is a brief one of about ten days." The larvae in an old molasses cask, with an inch of

sediment and two feet of running water, were believed by Dr. Morrey to be feeding on decaying Confervae growing in the tank. Some of them left the tank to burrow in the soft wet soil and decaying portions of a willow log. They did not appear to burrow into the mud at the bottom of the tank.

**Mallota**—Lintner, 1st N. Y. Report, 211, records the taking of two larvae of *M. posticata* from a birch tree, 25 rods from the nearest water, about 30 feet from the ground where a limb had been broken off causing a decay in the heart wood. The larvae "were sordid white or flesh colored, with a body of an oval form, about three-eighths of an inch in length, by about one-fourth of an inch when at rest, and about twice as long and of a diminished diameter when in motion. The tail-like projection from the narrower end an inch in length; slightly tapering, transversely wrinkled two-thirds its length; the remainder being a black, cylindrical, bristle-like process susceptible of projection or contraction within the anterior portion. When the grubs were taken from the fine, black mould in which they were buried they extended their front segments like the pushing out of an introverted glove-finger, and progressed moderately by the aid of several pairs of low, flattened, ventral tubercles, bearing on their circumference a number of closely set radiating spinules.

"The larvae did not pupate for about a month, presumably feeding upon the mould. Several times they emerged from the mould and traveled restlessly about the jar, finally remaining upon the surface. On the 16th of February they had contracted materially in size and become very pointed behind. The front segments assumed a darker shade. The two respiratory horns on the dorsum over the second pair of leg tubercles had become more prominent and were now about one-twentieth of an inch long. The tube containing the respiratory setae was dark brown. An irregular-shaped packet of excremental matter was attached to the anal orifice. Pupation was brief—12 days for a male and 14 for a female. Laterally on the puparium, seven slightly projecting, black spiracles may be seen with a lens, one over each leg tubercle." (If these are really *respiratory* spiracles the condition is very anomalous from what is known of Syrphid larvae.) "Ventrally between the tubercles are transverse rows of bristles, and outside of the tubercles are longitudinal rows, evidently of service in locomotion. The puparium is flattened beneath and rounded above. The respiratory tube is clearly seen to consist of three portions."

**Merodon**—Verrall reports the very interesting habit of the European *M. equestris* of passing its larval stage in bulbs of *Narcissi* and allied plants which they devour; apparently becoming serious pests, as will be

noted from these quotations from his "British Flies" pp. 556 and 559: "Serious damage was done in Cornwall on *Narcissus* bulbs in October, 1896, when one gardener alone had been compelled to destroy several thousand bulbs of *Narcissi* while many other records have been given in recent years of similar damage done near London and in other districts where bulbs are extensively cultivated.

"Mr. McLachlan gives the following interesting note on the breeding of this species in England (Entom. Month. Mag. XXXI. p. 114):—'The undoubted fact that *Merodon* is becoming more common here than it was formerly, is, no doubt, mainly due to the large importations of bulbs of *Narcissus* from the South of Europe. A friend of mine, a noted horticulturist, never observed any signs of the ravages of its larvae until after having purchased, in an unlucky moment, a bag of imported bulbs; since then it has occasioned great damage in his garden. It will feed on many kinds of bulbs. Recently it came under my notice as destroying those of *Eurycles*, an Australian genus. Bulbs of *Narcissus* (and probably of other plants), that have been attacked by *Merodon*, but not killed outright, are found next season to have divided themselves into a varying number of healthy smaller bulbs, so that, to some extent, the attacks of the larvae form a means of propagation.' "

Osten Sacken, Cat. 135, notes the occasional importation to North America of larvae in bulbs from Europe.

**Syritta**—Howard, Proc. Wash. Acad. Sci. II, 597. "*Syritta pipiens* Linn. The larvae of insects of this genus live in horse-dung and cow-dung in Europe. This species has been reported by Westwood as breeding in horse-dung and by Scholtz in cow-dung. The only specimen noted in the course of this investigation was taken in a privy at Newport, Oregon, by Dr. Hopkins."

**Xylota**—"The metamorphoses are sufficiently known to cause a belief that the larvae live in rotting wood."—Verrall, British Flies p. 597.

Daecke, Ent. News, XIV, 275, found larvae of *X. pigra* under the bark of a pine tree. They emerged as adults from May 25 to June 15.

Johnson, Psyche, Vol. 13, pp. 2, 3, Pl. I, Figs. 5 and 6 gives the following on *Xylota pigra*: "While searching beneath the bark of pine logs, I found the larvae of this species in considerable numbers. It frequented the wet bark near the ground where there was more or less fermentation of the sappy portions of the wood and bast. The larva is about 14 mm. in length, of a dirty yellow or brownish color with ten or eleven ill-defined rugosely wrinkled segments, covered with short hairs which are somewhat longer on the sides. The first segment is armed on each side

with a pair of black spines, the posterior one curved backwards; above the spines are small brown papillae; the posterior portion bears on each side three large, hairy, spine-like processes, and terminates with a prominent, shiny brown respiratory tube, showing slight annulations on the middle.

"The larvae were collected near Auburndale, Mass., March 26, 1905. They commenced pupating March 31, and continued to do so until April 3, the imagos appearing from April 12 to 15. The pupa is about 10 mm. in length; dark brown in color, the black spines and small papillae of the larva being still present with an additional pair of larger papillae above; the posterior portion also has a similar appearance to the larvae, retaining the lateral processes and respiratory tube. The imago emerges thru the upper portion of the first two segments."

**Chrysochlamys**—"The larvae live in the sap of ulcerated trees."—Verrall, Brit. Flies, p. 623.

**Brachypalpus**—Reared from larva found between loose bark on stump of a tree.—E. L. Keen, Canad. Ent. Vol. 16, p. 149, 1884.

"Metamorphoses probably occur in rotting portions of living trees."—Verrall, Brit. Flies, p. 593.

**Pocota**—"It lives in rotten poplar (*Populus*) stems. Metamorphoses well known, it seems to be more frequently bred than caught."—Verrall, Brit. Flies, p. 587.

**Criorhina**—"The metamorphoses are but little known, but the species are associated with the sap of rotten wood, probably occur in the sap which flows from injured or ulcerated trees, or the debris of floods from which *C. oxyacanthae* has been bred."—Verrall, Brit. Flies, p. 576, 577.

Sub-Family **Milesinae** (Verrall)—"What little is known about the metamorphoses shows that many species live in rotten wood or about the sap flowing from injured tree trunks."—Verrall, Brit. Flies. p. 561.

**Ceria**—The following notes on the puparium of *C. signifera* are given by C. W. Johnson, Ent. News, IV. 91. "This specimen (female) was given to me by Dr. Henry Skinner; with it was a card, to which was attached a leaf, and on this was a small pupa-case. On the card was written: 'Found near Bala, Pa. Dead oak leaf on ground; hatched May 13, 1889.' It is evidently the pupa of this fly. It is about 12 mm. in length (the anterior part being broken in hatching) the ground color brownish-gray, roughly and irregularly netted with black. There is a dorsal, binate row of dark brown tubercles with single lateral rows alternating with those on the back; above and below the lateral row there is

an obscure row of small tubercles, the posterior end has a long projection one fourth its total length, the greater part of which is a dark glossy brown. The ventral surface is flat and firmly attached to the leaf."

Nathan Banks, Proc. Ent. Soc. Wash., V., 310, gives the following on *Ceria willistonii* Kahl: "From a puparium collected on oak bark at Falls Church, Va., about the middle of March, there issued March 27, a fly of this species. It is probably identical with *C. signifera* Loew from Mexico. The larva of *Ceria* is supposed to feed in the flowing sap of trees. *Puparium*; dull black above, whitish below, in front with two large white marks separated by a narrow black spot; anal tube shining black. Dorsum faintly mottled with pale, more prominent on the sides. Dorsum with a median row of double pointed tubercles, and a lateral row each side; those toward the tip are smaller than the others. Length 18 mm."

**Eumerus**—"The European *E. strigatus* has been bred from bulbs of the common onion (*Allium cepa*) of which they sometimes destroyed a whole crop. The larvae occurred in July and pupated in the bulbs or in the neighboring earth. Sometimes bred from soft and rotten bulbs." —Verrall.

## Part III.

### KEY TO THE GENERA OF SYRPHIDAE*

1. Antennae with a terminal style (Fig. 152. s.) .......... 2
   Antennae with a dorsal (rarely subterminal) arista (Fig. 151) .......... 4
2. Antennae cylindrical, the first two joints elongated; first posterior cell with a stump of a vein .......... **Ceria** (p. 98)
   First two joints of the antennae short .......... 3
3. Eyes bare; small species .......... **Pelecocera** (p. 88)
   Eyes pilose; larger species .......... **Callicera** (p. 80)
4. Marginal cell of the wings closed and petiolate (Fig. 231) .......... 48
   Marginal cell open (Fig. 151) .......... 5
5. Anterior cross-vein of the wings distinctly before (basal to) the middle of the discal cell; almost always rectangular (Fig. 151) .......... 6
   Anterior cross-vein near or beyond the middle of the discal cell, usually oblique (Figs. 231, 246) .......... 55
6. Antennae elongate (Fig. 241; if arista plumose, see 56) .......... 7
   Antennae short (Fig. 240) .......... 14
7. Mesonotum with yellow lateral stripes; large species, the abdomen always with distinct yellow bands .......... **Chrysotoxum** (p. 80)
   Mesonotum not with distinct yellow lateral stripes or margins .......... 8
8. Face rounded, not tuberculate, pilose: oral margin not projecting (Fig. 208) ... 9
   Face not evenly arched; tuberculate or the oral margin projecting (Fig. 37, 209) 12

*After S. W. Williston.

9. Moderately large to large species; scutellum flattened, often with spines or tubercles on its border (Figs. 201, 202); a stump of a vein in the first posterior cell from the third longitudinal vein (Fig. 230) .......................... 10
Small species; scutellum without spines; no stump of vein in first posterior cell .......................................................... **Pipiza** (p. 81)

10. Abdomen much narrowed at the base .......................................... 11
Abdomen not or but little narrowed at base .................... **Microdon** (p. 79)

11. Face swollen and prominent below ............................ **Rhopalosyrphus**
Face not swollen and prominent below ............................ **Mixogaster**

12. Body clothed with sparse tomentum; all the femora thickened and with spinous bristles below (*Lepromyia*) ................................ **Lepidostola**
Body not clothed with flattened tomentum; the femora not thickened with spinous bristles below .......................................................... 13

13. Face partly or wholly yellow, tuberculate below, the epistoma not projecting; face and front not wrinkled .............................. **Paragus** (p. 82)
Front and face wholly black in ground color (*Chrysogaster*, *Rhysops*) ....... 19

14. Face black in ground color .................................................. 15
Face more or less yellow or yellowish in ground color ..................... 26

15. Abdomen only with four visible segments, very convex, the venter excavated; first two joints of the antennae very short, the third large, subquadrate, with a short subterminal arista ........................................ **Nausigaster**
Abdomen with more than four visible segments (Figs. 71, 151) .............. 16

16. Hind femora distinctly thickened (Fig. 212) .................................. 17
Hind femora but little or not at all thickened .................................. 18

17. Scutellum unusually large, nearly square (Fig. 203); males dichoptic........ ........................................................ **Chalcomyia** (p. 83)
Scutellum not unusually large, considerably broader at its base; males holoptic and with a facial tubercle ................................ **Myiolepta** (p. 83)

18. Face rounded, not tuberculate, the oral margin not projecting...... **Pipiza** (p. 81)
Face tuberculate or the oral margin projecting ................................ 19

19. Epistoma projecting (Fig. 209); small, black species ........................ 20
Face tuberculate, the oral margin not projecting (Fig. 243) .................. 21

20. Front in the female and usually the face in both sexes with transverse wrinkles, (Fig. 210); spurious vein obsolete; antennae short or long. **Chrysogaster** (p. 80)
Front and face not wrinkled; face pilose ........................ **Psilota** (p. 81)

21. Metallic green, metallic green and black, or black species; facial orbits separated by a slender parallel groove (Fig. 220) .................. **Chilosia** (p. 82)
Black with more or less metallic green or blue, with yellow, yellowish or metallic cross-bands on the abdomen; face not with orbital grooves ................ 22

22. Face with transverse grooves in the middle; (antennae elongate) ...... **Rhysops**
Face not with transverse grooves or wrinkles .................................. 23

23. Wings not longer than the abdomen; ocellar tubercle large; abdomen depressed, long elliptical, somewhat narrowed toward its base, the markings ferruginous or yellowish orange ................................................ **Pyrophaena**
Wings longer than the abdomen with yellow or greenish-yellow, or shining metallic cross-bands; usually elongate species .............................. 24

24. Front tibiae distally and the tarsi of the male dilated, those of the female slightly widened (Figs. 214-216 and 244) .......... **Platychirus** (p. 84)
Front tibiae and tarsi slender in both sexes .......... 25

25. Rather large, blackish species, with a large flat, elliptical abdomen. **Xanthandrus**
More elongate and slender species, abdomen not elliptical in outline .......... **Melanostoma** (p. 85)

26. Abdomen narrowed toward the base, distinctly club-shaped or spatulate in outline Fig. 217) .......... 27
Abdomen oval or slender, not spatulate or club-shaped in outline .......... 30

27. Third longitudinal vein bent deeply into the first posterior cell... **Salpingogaster**
Third longitudinal vein straight or gently curved (Figs. 151, 250) .......... 28

28. Hind femora slender; front of male long, narrowed above; the cheeks very narrow below the eyes; abdomen often very slender .......... **Baccha** (p. 83)
Hind femora thickened; front not unusually long in female .......... 29

29. Epistoma produced anteriorly, the face in profile deeply concave from antennae to tip; third joint of antennae rounded .......... **Sphegina** (p. 88)
Epistoma produced more downward, in profile gently concave; third joint of antennae not rounded .......... **Neoascia** (p. 89)

30. Front long, much narrowed above in the female (Fig. 224); cheeks very narrow, the eyes approaching each other at the lower third of the head; wings usually with dark picture; abdomen more or less elongate (compare *Baccha* when in doubt as to shape of abdomen) .......... **Ocyptamus** (p. 84)
Flies not having the above assemblage of characters .......... 31

31. Mesonotum with distinct yellow lateral margins (Figs. 64, 71) .......... 38
Mesonotum not with yellow lateral margins .......... 32

32. Abdomen with definite yellow cross-bands .......... 33
Abdomen not with definite yellow cross-bands .......... 42

33. Hind femora extraordinarily thickened (Fig. 234) .......... **Syritta** (p. 94)
Hind femora slender (Figs. 1, 71) .......... 34

34. Sixth abdominal segment in the male as long as the two preceding together, cylindrical; fifth segment of the female one-half as long as the preceding .......... **Eupeodes**
Sixth abdominal segment of the male not peculiar; the fifth segment of the female one-third or one-fourth as long as the preceding .......... 35

35. Front very convex; eyes of male with an area of enlarged facets above (*Lasiophthicus Catabomba*) .......... **Scaeva** (p. 40)
Front not remarkably convex .......... 36

36. Third longitudinal vein with distinct curvature into the first posterior cell (Fig. 1) third joint of antennae elongate oval .......... **Didea** (p. 85)
Third longitudinal vein straight or gently curved (Fig. 151); epistoma not produced (if produced snout-like, *Rhingia*, p. 89) .......... 37

37. Males holoptic (Fig. 9) .......... **Syrphus** (p. 85)
Males broadly dichoptic; arista more or less thickened .......... **Chamaesyrphus**

38. Mesonotum with median cinereous line; ocelli usually remote from the vertex 39
Mesonotum not with a median cinereous linear stripe .......... 40

39. Hind femora in the male thickened and arcuate, the tibiae dilated at the tip .......... **Toxomerus** (p. 87)
Hind femora simple and straight; the tibiae not dilated at tip. **Mesogramma** (p. 87)

40. Eyes of male with an area of enlarged facets above; fourth segment of abdomen with two median yellow stripes and oblique side spots (Fig. 64) **Allograpta** ........................................................ (p. 87)
Eyes of male not with an area of enlarged facets above; fourth abdominal segment not so marked ........................................................ 41

41. Face projecting below; slender species, the hypopygium often large (Fig. 71) ........................................................ **Sphaerophoria** (p. 88)
Face receding; abdomen oval ........................................................ **Xanthogramma** (p. 87)

42. Thickly pilose species; the abdomen black, the basal part light yellow. **Leucozona**
Thinly pilose species; abdomen not so marked ........................................................ 43

43. Hind femora thickened ........................................................ 44
Hind femora slender ........................................................ 47

44. Species wholly or chiefly reddish or lutescent ........................................................ 46
Black species, sometimes with luteous spots on face, humeri and basal angles of abdomen ........................................................ 45

45. Scutellum unusually large, nearly square in outline (Fig. 203); males dichoptic ........................................................ **Chalcomyia** (p. 83)
Scutellum oval; males holoptic ........................................................ **Myiolepta** (p. 83)

46. Face carinate; abdomen oval ........................................................ **Brachyopa** (p. 89)
Face tuberculate; abdomen more elongate ........................................................ **Hammerschmidtia**

47. Epistoma produced into a long porrect snout (Fig. 227) ........................................................ **Rhingia** (p. 89)
Epistoma not produced (compare *Paragus* sp. if small) facial orbits limited by a slender groove (Fig. 220) ........................................................ **Chilosia** (p 82)

48. Third vein bent deeply into the first posterior cell (Fig. 231) ........................................................ 51
Third vein not bent deeply into first posterior cell; third antennal joint elongate (Fig. 222) ........................................................ 49

49. Arista very densely plumose, appearing as a solid mass, the arista itself also thickened ........................................................ **Copestylum**
Arista feathery plumose (Fig. 222) ........................................................ 50

50. Hairs of arista retrorse; males dichoptic ........................................................ **Megametapon**
Hairs of arista not retrorse; males holoptic ........................................................ **Volucella** (p. 89)

51. Hind femora with a sharp tooth-like projection below near distal end (Fig. 237); sixth vein beyond anal cell strongly curved; large species ..... **Milesia** (p. 97)
Hind femora without such tooth ........................................................ 52

52. Frontal triangle of male strongly protuberant; rather large, dark colored species (*Priomerus, Doliosyrphus*) ........................................................ **Eristalis** (p. 90)
Frontal triangle not protuberant ........................................................ 53

53. Epistoma produced into a long porrect snout ........................................................ **Licastrirhyncha**
Epistoma not produced ........................................................ 54

54. Thorax with distinct yellow markings, hind femora thickened; hypopygium enlarged ........................................................ **Meromacrus** (p. 92)
Thorax not with distinct yellow markings, sometimes white-fasciate; femora sometimes thickened; hypopygium not conspicuously prominent.... **Eristalis** (p. 90)

55. Arista plumose (Fig. 222) ........................................................ 56
Arista bare or pubescent (Fig. 241, 221) ........................................................ 60

56. Antennae elongate, the third joint more than twice as long as wide (*Phalacromyia, Glaurotricha*) (Fig. 222) ........................................................ **Volucella** (p. 89)

Antennae short, the third joint not more than twice as long as wide; third vein nearly straight, or gently or considerably curved into first posterior cell.... 57

57. Thinly pilose; abdomen with yellow bands.................................. 58
Thickly pilose; abdomen not with yellow bands.............................. 59

58. Third vein straight or moderately curved (Fig. 238)........ **Sericomyia** (p. 90)
Third vein considerably curved..................................**Condidea Coq**

59. Eyes pubescent.................................................. **Pyritis**
Eyes bare.......................................................**Arctophila**

60. Third longitudinal vein deeply curved into first posterior cell............... 61
Third vein only gently curved................................................ 70

61. Hind femora thickened.................................................. 63
Hind femora slender.................................................... 62

62. Abdomen elongate, narrowed at base, spatulate in outline........ **.Salpingogaster**
Abdomen oval, with yellow, interrupted bands; mesonotum with yellow margins; antennae elongate (Fig. 241)..........................**Chrysotoxum** (p. 80)

63. Face carinate or subcarinate; hind femora with an angular protuberance or spur below at outer end (Fig. 233):
Face protuberant in profile (Fig. 229)........................**Tropidia** (p. 92)
Face concave in profile, subcarinate; spur of femora bifid.........**Senogaster**
Face tuberculate or arched, not keeled........................................ 64

64. Abdomen much narrowed at base, club-shaped.......................**Ceriogaster**
Abdomen not at all pedunculate or basally narrowed.......................... 65

65. Antennae elongate; eyes pubescent; wings colored anteriorly............. ........................................ "**Platynochaetus**" *niger*. female.
Antennae not elongate.......................................................... 66

66. Third joint of antennae broad; mesonotum not vittate......................... 68
Third joint of antennae oval.
Males holoptic; femora with protuberance below....................**Merodon**
Males dichoptic; femora not with protuberance................................ 67

67. Ocelli remote from each other; mesonotum not vittate............**Asemosyrphus**
Ocelli not remote from each other (Figs. 218, 219); mesonotum vittate **Helophilus** ................................................................(p. 92)

68. Thickly pilose species..........................................**Mallota** (p. 93)
Thinly pilose................................................................ 69

69. Hind tibiae of male with an internal spur (compare *Mallota* sp.)............ ............................................................**Teuchocnemis**
Hind tibiae of male not with such spur (*Triodonta*, *Polydonta*)............. ..................................................**Pterallastes** (p. 94)

70. Thorax with distinct yellow markings other then on the humeri; wasp-like flies ........................................................................ 81
Thorax not with distinct yellow markings of the ground-color other then rarely on the humeri .......................................................... 71

71. Hind femora swollen and with a protuberance or spur below distally; face carinate or subcarinate ............................................... 72
Hind femora not with such protuberance or spur................................ 73

72. Face concave in profile; femoral spur bifid.........................**Senogaster**
Face protuberant in profile; femoral protuberance not spur-like (Fig. 233) ........................................................**Tropidia** (p. 92)

73. Abdomen narrowed basally; slender species (see 27).
Abdomen in no wise club-shaped ........................................ 74
74. Face transversely arched, not produced, not tuberculate, abdomen more or less elongate and nearly bare ........................................ 75
More or less thickly pilose species; often large ........................................ 76
75. Hind femora extraordinarily thickened (Fig. 234); anterior cross-vein rectangular, and before the middle of discal cell ........................ **Syritta** (p. 94)
Hind femora distinctly thickened, but the cross-vein distinctly oblique, and near or beyond middle of discal cell ........................ **Xylota** (p. 94)
76. Scutellem, margin of thorax and pleurae with distinct bristles, femora slender (*Chrysochlamys*) ........................................ **Ferdinandea**
No bristles anywhere on body ........................................ 77
77. Face short, not produced, concave from antennae to oral margin, not tuberculate; hind femora thickened ........................................ 78
Face produced, long ........................................ 79
78. Abdomen elongate ........................................ **Brachypalpus** (p. 95)
Abdomen very broad; thorax densely pilose; middle femora of male sometimes (*Hadromyia*) with a stout, basal, inferior spur ........................ **Pocota**
79. Face produced forward, pointed, concave from antennae to tip, not tuberculate; hind femora thickened ........................................ **Crioprora** (p. 96)
Face not evenly concave in profile, but tuberculate or convex ............. 80
80. Third joint of antennae produced above into an anteriorly directed, conical process, terminating in the thickened arista (Figs. 225, 226) **Merapioidus** (p. 96)
Third joint of antennae obliquely oval; hind femora rarely thickened... ... ........................................ **Criorhina** (p. 96)
81. Hind femora with conical, tooth-like protuberance below near distal end; antennae more or less elongated; sixth vein directed obliquely outward beyond anal cell ........................................ **Spilomyia** (p. 97)
Hind femora without much protuberance; sixth vein beyond anal cell not unusual ........................................ 82
82. Antennae inserted low down, near middle of head in profile, the face not longer than front (Fig. 235) ........................................ **Temnostoma** (p. 98)
Antennae inserted on a conical process; front short, the face much produced downward (Fig. 236); antennae long or short ............. **Sphecomyia** (p. 98)

In the following discussion of genera, species known to occur in the State are consecutively numbered and their names printed in **bold face type**. In addition certain species, whose known distribution indicates probable occurrence, are included with the hope of adding to the usefulness of the paper. Names of such species are unnumbered, printed in *italics* and marked with a star (*). Their recorded distribution is indicated following the name.

## **Microdon** Meigen

1 Hind metatarsi not, or but slightly thickened; third segment of antennae about as long as the first, blackish species, abdomen without orange yellow . . **tristis**
Hind metatarsi strongly thickened in the male, brownish species........... 2
2 Third joint of antennae longer than the first ..................... **fuscipennis**
Third joint of antennae not longer than the first ........................
................**globosus* Fab. (Mich., Col., Va., N. J., Fla., Carolina, Tex.)

1 **M. fuscipennis** Macquart. Six specimens taken at Cincinnati (Dury) (Fig. 201, 204, 206, 230).

2 **M. tristis** Loew. Eight specimens taken at Cincinnati (Dury) (Figs. 202, 205, 207).

*M.* **aurifex* Wied. (Philadelphia), **aurulentus* Fab. (Pa., Car.) **megalogaster* Snow, (Pa., Va., N J., Col.) and **rufipes* Macq. (Pa., La.,) also seem likely to be taken in Ohio. Description of *megalogaster* by Snow in Kans. Univ. Quart. I. 34; the others are described by Williston, Synopsis, pp. 9-12.

## **Callicera** Panzer

**C. johnsoni* Hunter (Pa., N. C.),

## **Chrysotoxum** Meigen

1 Lateral margin of third abdominal segment yellow; second and third abdominal arcuate yellow bands only interrupted by a line.............. **laterale**
Lateral margin of third segment not all yellow; second and third arcuate bands distinctly interrupted........................................ 2
2 Black spot of the fifth abdominal segment inverted Y—shaped.............. ............................**ventricosum* Loew (Can., D. C., Ariz., N. J.)
Black spot of the fifth abdominal segment inverted V—shaped .......... ........ ............. .....**pubescens* Loew (Ill., N Y., Mich. Va., N. J.)

3 **C. laterale** Loew. One female, Medina, one male, Ira, August. Fig. 241.

## **Chrysogaster** Meigen

1 Base and tip of tibiae, or at least first two joints of tarsi, yellow or yellowish-red; last section of fourth longitudinal vein rectangular; antennae elongate. 2
Legs wholly black; last section of fourth vein curved or bent; third joint of antennae rounded, nearly as broad as long, front of female strongly rugose ...... ............................................................ **nigripes**
2 The last section of the fourth vein joins the third beyond the tip of second vein, rectangular, with a stump of a vein in the middle; second joint of antennae nearly as long as the third; eyes with linear markings...... **nitida**
The last section of fourth vein joins the third opposite or before the tip of the second; disk of abdomen opaque.......... ........................... 3
3 Abdomen broadly oval; wings with browinsh clouds....... ......**pictipennis**
Cross-veins of wings not clouded .......... ............................. ......... . **pulchella* Willst. (Mich. N. H., Conn., Can.,N. J.) (Fig. 247)

4 **C. nigripes** Loew. One male, Columbus, four females, Columbus, Hinckley and Ft. Ancient; last of May to first of August. (Figs. 209, 245.)

5 **C. nitida** Wiedeman. One male, Ft. Ancient, three Sandusky; three females Columbus, Sandusky, Wauseon, last of May to last of August. (Figs. 210, 248).

6 **C. pictipennis** Loew. One female has wings nearly clear. Three specimens, Medina, Columbus, Ira; April 23 and early August. (Figs. 211, 249).

**Chrysogaster apisaon* Walk (N. Y.).

## **Psilota** Meigen

**P. flavipennis* Macq. (Philadelphia).

## **Pipiza** Fallen

1 Abdomen with a basal interrupted yellow fascia .... 2
Abdomen uniformly black .... 3
2 Wings with a brown spot in the middle .... **festiva**
Wings without a brown spot in the middle .... **femoralis**
3 Third joint of antennae at least twice as long as wide .... 4
Third joint scarcely twice as long as wide, or rounded .... 5
4 Third joint of antennae elongate; hind metatarsi much thickened; last section of fourth vein bent near its middle .... **pulchella**
Third joint elliptical, hind metatarsi but slightly thickened; last section of fourth vein bent at its antepenultimate third .... **radicum**
5 Black pilose .... **nigripilosa**
Chiefly light pilose .... 6
6 Wings with brownish cloud, abdomen chiefly light pilose .... **albipilosa* Willst (Pa.)
Wings without a brown cloud .... **pisticoides**

Hind coxae armed with a long slender process, dilated and compressed toward the end .... **calcarata* Loew (N. Y., N. J.)

**P. modesta* Loew (N. Y., Can., N. J., N. M.) **nigribarba* Loew (N. Y.) **fraudulenta* Loew? (Ill.) and **salax* Loew (Pa.) may be expected in the State. For descriptions of these species see Williston Synopsis, pp. 24-26.

7 **P. femoralis** Loew. 15 males, 2 females, Columbus, Sugar Grove, Ira; all taken in May.

8 **P. festiva** Meigen. 6 females, Columbus, June: 2 females, Ira, September. Can this be the female of *P. femoralis*?

9 **P. nigripilosa** Williston. One male, Hinckley, late June.

10 **P. pisticoides** Williston. 9 males, 8 females, Medina, Hinckley, Columbus; late April to early August. (Fig. 208).

11 **P. pulchella** Williston. One male, Lockbourne, July 3; three females, Medina, Akron, Ft. Ancient, July to August.

12 **Pipiza radicum.** Walsh and Riley. One female, Columbus, September 15.

### **Paragus** Latreille

1 Scutellum with a yellow border, at least in the female; face of male without a black median stripe; front of female narrow above.............. **bicolor**
Scutellum without a yellow border; face in both sexes with a black median stripe; front in female of nearly equal width .... ...................... 2
2 Abdomen with more or less red on the dorsum; vertical triangle in the male large....................................................... **tibialis**
Abdomen wholly greenish-black .............................. **angustifrons**

13 **P. angustifrons** Loew. 9 females, Columbus, Sandusky, Cincinnati, Waterloo, Kent, Vinton, Lockbourne, Sugar Grove; first of May to the last of July.

14 **P. bicolor** Fabricius. For description of this species see Part II, p. 53 where the immature stages are also described. Many specimens are at hand from Columbus, Lakeville, Sandusky, Wauseon, Castalia, Vinton and Gypsum; early May to late August.

15 **P. tibialis** Fallen. Descriptions of the life stages are given in Part II p. 54. Numerous specimens, mostly males, Akron, Sandusky, Medina, Vinton; middle of May to early August.

### **Chilosia** Meigen

Key to Species (adapted from Hunter,

Canad-Ent. Vol. XXVIII, pp. 229-233, September., 1896.)

1 Eyes bare, tibiae at least largely yellow. .... ........................... 2
2 Scutellum without bristles or bristle-like hairs on the margin.............. 3
Scutellum with bristles or bristle-like hairs on the margin ............. .. 5
3 Posterior femora largely reddish, or at least so colored at the base; second abdominal segment partly opaque; four anterior tibiae entirely yellow ..............................................**prima* Hunter (Pa.)
Posterior femora except the tip always black......... ................. 4
4 Abdomen entirely shining in both sexes..................... .......**comosa**
Abdomen at least in the male largely opaque; four anterior tibiae entirely yellow; pile of front light colored............... ..................**capillata**
5 Arista briefly pubescent, femora yellow.................**prima* Hunter (Pa.)
Arista plumose or long pilose, third antennal joint rounded-ovate or ovate.. 6
6 Abdomen of both sexes entirely shining, anterior femora largely black ..... .......... . ...**cyanescens* Loew (Ill., Conn., N. H., Montreal)
Abdomen in the male largely opaque..... ............................ 7
7 Posterior femora on basal third, and at apex, yellow; scutellum yellow except the narrow base .......... ................................ ......**pallipes**
Posterior femora except the apex black; scutellum only piceous at apex; first posterior cell broader and last section of fourth longitudinal vein accordingly longer................ ..... ................................**tristis**

16 **C. capillata** Loew. One male, Columbus, April 23.

17 **C. comosa** Loew. One female, Columbus, May 13.

18 **C. pallipes** Loew. One female, Vinton, Early June. (Fig. 243.)

19 **C. tristis** Loew. One male, Hinckley, August 1.

## **Chalcomyia** Williston

20 **Chalcomyia aerea** Loew. Three males, one female, Cincinnati, Columbus, Georgesville; late April, early May. One male with rat-tailed puparium bears this label, "Pupa taken under bark, Columbus, Ohio, 4-11-02." (See Part II, p. 63, Figs. 203, 212.)

## **Myiolepta** Newman

1 Face on the sides below with a large luteous spot, third joint of antennae ovate........................................**strigilata**
Face without a luteous spot below........................................2
2 Legs partly yellow, abdomen black........................................**nigra**
Legs partly yellow, abdomen with luteous or yellow spots at the base........................................**varipes**

21 **M. nigra** Loew. Two males, two females, Hinckley, Ft. Ancient; mid-June and early August.

22 **M. varipes** Loew. Two males, two females, Columbus, Sandusky, Ft. Ancient, Hinckley; mid-June to early August.

23 **M. strigilata** Loew. Five specimens, Cincinnati, May, 1901. A male, Columbus, May 13, resembles *M. strigilata* Loew but lacks the luteous facial spots and has the eyes separated by the width of two and a half facets. Length 5.5 mm. Blackish-greenish, moderately shining, clothed with short, rigid, appressed, yellowish-white pile. Vertical triangle black, shining, long. Frontal triangle and face thickly clothed with whitish pollen and pile except for a brown spot above the antennae. A black spot on tubercle and thence to oral margin, and the cheeks; first two joints of antennae dark brown, third joint light ferruginous, ovate, a little longer than broad, arista concolorous. Legs and wings as in *M. strigilata*. Tip of marginal cell somewhat dilated into sub-marginal cell.

## **Baccha** Fabricious

1 Abdomen distinctly narrowed toward the base; elongate, more or less club-shaped or spatulate........................................2
2 Third joint of the antennae elongate oval, obtusely pointed; face very prominent........................................**clavata**
Third joint short oval, obtusely rounded; face not prominent........................................3

3 Wings cinereous hyaline, without distinct dark markings; abdomen very slender........................................................**cognata**
Wings more or less brownish or blackish...................................... 4
4 Wings with a broad median cross-band, reaching to the fourth posterior cell; scutellum and posterior part of the dorsum shining golden .....**fascipennis**
Wings with the front border, at least, for its whole length brownish or blackish.................................................................. 5
Wings with front border narrowly darkened but not for its full length; body black, the first second and third abdominal segments with an oblique white spot on each side at base.............................**costata* Say (Ind.)
5 Posterior half of the wings nearly hyaline.........................**tarchetius**
Wings more or less brown or blackish on the posterior part................ 6
6 Wings subcinerescent; all the veins, except the last segment of the fourth broadely clouded with blackish, confluent near the costa.............. ..............................**lugens* (Loew N. Y. Wisc., N. J., Fla.)
Wings with a triangular hyaline space behind the outer end of third vein, the axillary portion more or less subhyaline. *Ocyptamus fuscipennis* Say, See Ocyptamus (below)................................................**fuscipennis**

24 **B. fascipennis** Wied. Three males, four females, Sandusky, Cincinnati, Ira, Hinckley, Wauseon; last of May to early September.

25 **B. clavata** Fabr. Two Ohio specimens, male and female, November 2. (Fig. 217.)

26 **B. cognata** Loew. A small delicate species. One female, Ira, September 8.

27 **B. tarchetius** Walker. Two males, one female, Sandusky, Medina, Hocking Co. (Fulton); Early July to early August.

### **Ocyptamus** Macquart

28 **O. fuscipennis** Say. Common: Sandusky, Medina, Ira, Lakeville, Hinckley, Lochbourne; July 1 to September 9. (Fig. 224.)

### **Platychirus** St. Fargeau and Serville.

1 Front tibiae in the male gradually dilated from the base, the tarsi gradually decreasing in width from the base to the tip; profile of the face only gently concave above the tubercle, the latter small; cheeks convex below....... 2
Front tibiae of the male slender, suddenly dilated at the tip, metatarsi much dilated, the remaining joints but slightly so; the front femora in the male with a thick row of hairy pile on the posterior side; face in both sexes with a conspicuous tubercle; cheeks concave below .........**peltatus**
2 Front tibiae of the male, on the inner side toward the end, somewhat concave the outer angle produced into a lappet-like process, yellow spots on the abdomen in both sexes very large, leaving only a median stripe and cross-bands; hind femora and tibiae yellow..............................**quadratus**
Front tibiae of the male gently and evenly convex on the inner side, the tip on the outer side less produced, more angular; second segment of the abdomen in both sexes with a small rounded spot on each side, fifth segment in the male without yellow, legs chiefly black .........**hyperboreus**

28 **P. hyperboreus** Staeger. Numerous specimens Columbus, Lakeville, Sandusky, Ira, Vinton, Mediua, Hawkins, Milan, Newark; mid-April to late July. (Figs. 214, 240, 244.)

29 **P. peltatus** Meigen. One male, three females, Wauseon, Akron Hinckley; late July to late August. (Figs. 215, 242.)

30 **P. quadratus** Say. Ten males, four females, Columbus, Lakeville, Sandusky, Ira, Hinckley, Danville; early April to early September. (Fig. 216.)

## **Melanostoma** Schiner

1 Hind metatarsi not thickened, abdomen in the male with three pairs of quadrate reddish-yellow spots, tubercle of face not prominent; abdomen in the female oval with four pairs of triangular spots ........... . ..... **mellinum**
Hind metatarsi of the male always somewhat thickened; bands of abdomen metallic or greenish, not reddish-yellow; pollen of face (uniform or) somewhat ripple like but not of distinct circular spots; pile of thorax dusky ........................................................... **obscurum**

31 **M. mellinum** Linne. Numerous specimens, Columbus, Lakeville, Sandusky, Medina, Ira, Hinckley, Kent; middle of April to middle of August.

32 **M. obscurum** Say. Very common. Specimens from Columbus, Lakeville, Cincinnati, Vinton, Hinckley, Wauseon; late March to late August. (Fig. 250.)

## **Didea** Macquart

33 **D. fasciata** Macquart var. **fuscipes** Loew. For description of stages see Part II, p. 58.

## **Syrphus** Fabricius

1 Three principal yellow bands of abdomen entire, the second and third ones not reaching the lateral margin; face with a brown stripe...... **americanus**
First yellow cross-band interrupted, the others entire........ ... ........ 2
Three principal yellow bands interrupted; eyes bare; abdominal spots of third and fourth segments distinctly arcuated .... .................. 10

2 Abdomen narrow, with nearly parallel sides in the male; in the female the fifth segment half as long as the fourth ...................... **diversipes**
Abdomen distinctly oval, the fifth segment in the female less than half as long as the fourth.................. ............ ..... .... .......... 3

3 Femora black at the base........................................ 4
Femora yellow at the base........................................ 7

4 The first, second, and third abdominal cross-bands do not reach the lateral margin, eyes bare, cheeks black...... .................... . **americanus**
The second and third yellow-bands reach the margin........... .......... 5

5 Eyes pubescent .................................................. **torvus**
Eyes bare .................................................. 6
6 The cross-bands attenuated at their ends .................................. **ribesii**
The cross-bands reach the sides in nearly their full width .......... **grossulariae**
7 The second and third abdominal cross-bands do not quite reach the lateral margin; cheeks black, face with a brown stripe .............. **americanus**
The second and third bands attain the lateral margin ...................... 8
8 The second and third cross-bands not distinctly attenuated at their ends, the bands broad; face and cheeks wholly yellow, the thorax with a distinct yellow pilose and pollinose lateral band .................... **xanthostomus**
The second and third bands distinctly narrowed at their ends; thorax not with distinct yellow lateral pollinose bands, face and cheeks yellow .......... 9
9 Hind femora in the male entirely yellow; abdomen in the female broader, the bands narrower .................................................. **protritus**
Hind femora in the male black ................................ **ribesii** male
10 Third vein of wings nearly straight; pile of pleurae white. Two rounded separated spots above the antennae ........................ **perplexus** Osburn†
Third vein strongly curved; pile of pleurae yellowish; a single biarcuate black band above the antennae. .**arcuatus* Fallen, (D. C., N. J., Col., Wash., Ariz., Can. etc.)

34 **S. americanus** Wiedemann. For descriptions of stages see Part II, pp. 54-55. Very abundant, middle of May to middle of September apparently all over the state. See note on variety? pp. 55-56.

35 **S. diversipes** Macquart. One male, Cincinnati, April 20.

36 **S. grossulariae** Meigen. One male, one female, Ira; late August, early September.

37 **S. perplexus** Osburn. Six specimens from Cincinnati.

38 **S. protritus** Osten Sacken. One female, Wauseon, Sept. 10. Two other females resemble this species closely but have the base of the femora black.

39 **S. ribesii** Linne. Numerous males and females, Columbus, Lakeville, Sandusky, Ira, Vinton, Medina; April to September inclusive.

40 **S. torvus** Osten Sacken. For description of adult, larva, and pupa see Part II, p. 56-57. Common Columbus, Lakeville, Ira, Vinton; middle of April to middle of September.

41 **S. xanthostomus** Williston. For complete description of adult, larva and pupa see Part II, p. 57. Very common, Columbus, Sandusky, Ira, Akron, Hinckley, Medina, Blendon, Lockbourne, Kent; mid-May to mid-September.

†Journal N. Y. Ent. Soc. Vol. XVIII, No. 1, pp. 53-57, March, 1910.

## **Allograpta** Osten Sacken

42 **A. obliqua** Say. For description of life-stages see Part II, p. 58. Common, Columbus, Lakeville, Sandusky, Put-in-Bay; early July to early September.

## **Xanthogramma** Schiner (*Philhelius*)

1 Dorsum of thorax before the scutellum with two, coalescent, light-yellow spots; wings with a brown anterior margin......**aequalis* Loew ( Pa., D. C., N. J.)
Dorsum of thorax without yellow spots on hind margin; wings not brown in front........................................................ 2
2 Pleurae with distinct *bright* yellow spots of ground color.......... **flavipes**
Pleurae without distinct *bright* yellow spots of ground color............. 3
3 Yellow band on second abdominal segment attains the lateral margin; all three abdominal bands often interrupted; black stripes on front of female thinning out before reaching the antennae; antennae and hind leg usually dark........................................ **emarginata**
The yellow band of the second abdominal segment is separated by a distinct black interval from the lateral margin, the abdominal bands usually distincly narrowed at the ends; black stripe on front of female reaches the antennae, slightly expanded below; antennae and hind legs usually lighter ........................................................**felix**

43 **X. emarginata** Say. Two males, Wauseon, and seven females, Ira; August 23 to September 9.

44 **X. felix** Osten Sacken. Very near to *X. emarginata*. Six females, Ira, Wauseon; August 28, September 7. (Fig. 223.)

45 **X. flavipes** Loew. Four males, Sandusky, Cincinnati, Hinckley; one female Ira; early June to late August.

## **Mesogramma** Loew (*Toxomerus*)

1 Hind femora in male thickened and arcuate, the tibiae dilated at tip **geminata**
Hind femora in male simple................................................ 2
2 Scutellum yellow, legs yellow, except the hind tarsi...................... 3
Scutellum black with yellow margin; front of female much narrowed above hind femora in part black......**boscii* Macq. (Montreal, N. J., Fla., Ga.)
Scutellum black or brown with a yellow border; front of female above only a little narrowed; hind femora wholly yellow...............**marginata** vart
3 Front of female only a little narrowed above; third to fifth abdominal segments with narrow lateral yellow margins.....................**marginata**
Front of female much narrowed above; third to fifth abdominal segments no yellow on the margins............................................**polita**

46 **M. geminata** Say. Five males and one female, Columbus, Medina, Wauseon; early May to mid-September. (Fig. 213.)

47 **M. marginata** Say. A very abundant species, variable in the extent and distinctness of the black markings on the abdomen. Specimens at hand from Columbus, Ira, Medina, Akron, Lakeville; May to September.

48 **M. polita** Say. Eight specimens, Columbus, Lakeville, Medina, Portsmouth; late March to early September.

### **Sphaerophoria** St. Fargeau and Serville

1 Hypopygium large with a tuft of yellow pile below the globular part in front .......... 2
Hypopygium and its pile blackish; yellow thoracic margin distinct only to the suture; abdomen all black except for a narrow, interrupted, translucent fascia on the hinder part of the second, and a pair of large translucent quadrate spots on the front part of the third abdominal segments.... **nigricauda**

2 Larger species about 10 mm. long; yellow thoracic margins distinct to the scutellum; black median stripe on front of female narrowing below; narrow black fascia on the oral margin in front; pecular color design on fourth and fifth abdominal segments in the male.......... **sp.**
Smaller species 6 to 10 mm. the yellow thoracic margins distinct only to the suture; black stripe on front of female widened below above the antennae, black fascia on oral margin in front indistinct or wanting.......... **cylindrica**

49 **S. cylindrica** (Say). For descriptions of life-stages see Part II. p., 59. Abundant, Lakeville, Columbus, Akron, Vinton, Ira; April 21 to October, especially abundant June and July.

**S. sp.?** This form seems more or less distinct from *cylindrica* as indicated above but it may be a variety of the former. The abdominal color pattern suggests that it may be the *S. scripta* Linne of Europe and Canada. Numerous specimens, male and female, Lakeville, Ira, Columbus; mid-June to mid-September.

50 **S. nigricauda** Hine (Mss.) One male, Sandusky Hine, very distinct from the other species of the genus.

### **Pelecocera** Meigen

**P. pergandei* Willst. (D. C.)

### **Sphegina** Meigen

1 Front in female much longer than broad.......... 2

2 Fifth abdominal segment in female considerably broader than long; posterior part of abdomen in males, dark brown or black, marked with yellow or reddish; cross-bands interrupted or entire; hind femora dark brown at least on distal half.......... **lobata**
Fifth abdominal segment in female but little broader than long .......... 3

3 Thorax more or less black; posterior part of abdomen in male reddish-brown unmarked; hind femora light brown or reddish-yellow on distal half.......... **rufiventris**

Thorax not at all black (female); reddish-yellow; abdomen yellow with black markings........................**keeniana* Willst. (Phila., N. H., N. J.)
Thorax entirely reddish (male); abdomen entirely reddish, shining ........................................ **campanulata** Robertson (Ill.)

51 **S. campanulata** Robertson, One male, Cincinnati, June 23, 1900 (Dury).

52 **S. rufiventris** Loew. Three specimens, Vinton; mid-June.

53 **S. lobata** Loew. Three females, Medina, Vinton, Cincinnati mid-June and mid-August; one male Hinckley, last of July.

## Neoascia Williston

54 **N. globosa** Walker. One female has the front and thorax black without any aeneous, the abdominal spots triangular, with apex towards the sides and the four front tibiae and femora with distinct narrow dark rings. Five females and an equal number of males, Columbus, Akron, Ira, Hawkins; mid-May to mid-August.

## Rhingia Scopoli

55 **R. nasica** Say. Seven specimens, Medina, Akron, Ira, Wauseon mid-July to early September. One male bears the label "on horse." (Fig. 227.)

## Brachyopa Meigen

56 **B. vacua** Osten Sacken. One male, Columbus, May 6, "on *Prunus serotina*." One female, Cincinnati, April 30, 1904 (Dury).

## Volucella Goeffrey

1 Thorax and abdomen very thickly pilose, that on the thorax and pleurae wholly yellow; face much excavated below the antennae, black or chestnut; arista very long and densely plumose; second segment of the abdomen yellow on the sides; wings with dark brown spot; large species................**evecta**
Thorax and abdomen not densely pilose................................ 2

2 Second vein bent into the sub-marginal cell near the end; wings sub-fasciate with brown; cheeks with a narrow yellow stripe; third joint of antennae not notched above, face produced downwards; pleurae with five or six yellow spots; yellow abdominal bands entire; small species................**fasciata**
Second vein not bent into the sub-marginal cell near the end, wings hyaline with a faint brown spot at the tip of the auxiliary vein, thorax and abdomen resplendent coppery, green or violet, the base of the latter yellow or translucent............................................**vesiculosa**

57 **V. evecta** Walker. Three specimens, Columbus, Ira, Kent; June, July. (Fig. 222.)

58 **V. fasciata** Macquart. One male, Sandusky; June 17.

59 **V. vesiculosa** (Fabricius). Two males, Cincinnati, July 3, 1900 one female, Cincinnati, June 20, 1901.

## **Sericomyia** Meigen

1 Second abdominal segment with two yellow dots or wholly black; hind femora of male considerably thickened .................................. **militaris**
Second abdominal segment with a median, interrupted fascia; yellow bands narrowly interrupted, the spots not constricted .................. 2
2 Fourth segment (in the male at least) without yellow cross-bands.........
..................................... **bifasciata* Willst. (N. H., Pa., N. Y.)
Second, third and fourth abdominal segments each with a median interrupted fascia; the elongate spots thus formed, oblique, not constricted in the middle ................................................. **chrysotoxoides**

60 **S. chrysotoxoides** Macquart. One male. Medina; July 22.

61 **S. militaris** Walker. One female, Columbus, May 30, "at light." (Fig. 238.)

## **Eristalis** Latreille

1 Scutellum of the same color as the thorax, abdomen without light markings, wholly shining; eyes bare (except on uppermost part) with small round dark spots (sometimes disappearing after death); dorsum of thorax in female distinctly vittate; arista bare.................................. **aeneus**
Scutellum more or less yellowish or reddish; eyes distinctly pilose, not so spotted........................................................... 2
2 Third segment of abdomen wholly shining, without opaque spots or bands 3
Third abdominal segment with opaque markings ........................ 5
3 Pile of eyes not confined to a vertical stripe; the black of second abdominal segment at least in part opaque; wings hyaline, femora not thickened... 11
Pile of eyes mostly confined to a vertical stripe; abdomen wholly shining; large species ..................................................... 4
4 Honey-bee like in appearance; moderately pilose; base of tibiae yellowish; posterior tarsi blackish; arista nearly bare.......................... **tenax**
Bumble-bee like in appearance; thorax and abdomem with thick long pile; arista plumose, hind tarsi red.................................... **flavipes**
5 Thorax with one or more distinct light dusted transverse bands; front in female narrow above.............................................. 9
Thorax without such transverse bands.................................. 6
6 Thickly pilose species. Third abdominal segment with a posterior opaque cross-band; fourth segment wholly shining......................... **bastardi**
Moderately pilose species.............................................. 7
7 Third abdominal segment with a posterior, velvety black cross-band not interrupted in the middle ........................................... 8
Third segment with an interrupted opaque cross-band behind and a similar spot in front; the opaque of second segment with a triangular shining spot behind; fourth segment with an oval spot in front.............. **dimidiatus**

8 Third segment with an opaque spot in front, broadly and conspicuously yellow on the sides, joining the yellow of the second segment; the black of the second segment wholly opaque not extending outwards on the sides behind; fourth segment metallic; eyes briefly contiguous in the male ................ **meigenii**(brousi Willst.)

Third segment not conspicuously yellow, the posterior opaque fascia of second segment behind reaching toward the lateral margin, the side-spots inconspicuous; third and fourth segments with a narrow anterior velvety fascia; eyes broadly contiguous in the male; front of female narrow; deep bluish-black; scutellum but very little lighter................. **Saxorum* Wied. (Pa., N. J., Mass., Conn., Ga., N. C.)

9 Hind femora slender; frontal triangle and front below (female) with black pile, arista briefly pilose; opaque black of second segment extends nearly the whole width of the front border................. ........... ............... ........ **transversus**

Hind femora dilated or thickened...... ................................ 10

10 Front of triangle thickly white pilose, lower part of front in the female not wholly so; third abdominal segment wholly opaque in the male; with a shining cross-band, and the second segment broadly black in the middle in female. Dorsum of thorax, besides the front border with two complete light cross-bands (female) or only one along suture (male)...................... **albifrons* Wied. (Car., Ga., Fla)

Pile of lower part of front or the frontal triangle wholly white or yellow; third abdominal segment with a shining cross-band, second segment narrowly black in the middle, dorsum of thorax with two complete light cross-bands, besides the front border.................................. **vinetorum* Fab (Phila., Fla.)

11 Second segment of abdomen with yellow lateral triangles, and a posterior interrupted or sub-interrupted velvety cross-band; posterior margin of segments 2-4 yellowish white with a fringe of pale golden pile... ...................... **latifrons**

Second segment except the obsolete or metallic side spots, which extend the whole length of the segment, velvety black; third usually with a velvety triangle in front; the fourth with a similar but very small one; the yellowish white hind borders fringed less conspicuously with light colored pile..... .................... **meigenii**

62 **E. aeneus** Scopoli. For description of larva, pupa and adult see Part II. p. 61. Numerous specimens, mid-April and late September. Columbus, Cincinnati.

63 **E. bastardii** Macquart. Seven males and three females, Columbus, Sandusky, Castalia, Akron; late April to late August.

64 **E. meigenii** Wied. One male, one female, Akron and Castalia; late June and mid-July. Three males, Lakeville; mid-June.

65 **E. dimidiatus** Wiedemann. A very abundant species the first of April about willow (*Salix* sp.); 50 specimens, Lakeville, Columbus, Sandusky, Ira, Vinton, Georgesville; late March to early October. (Fig. 252.)

66 **E. flavipes** Walker. Seven males and three females, Columbus, Sandusky, Milan; middle of May to late August. (Fig. 221.)

67 **E. latifrons** Loew. Taken by Dury at Cincinnati, April 4 to October 30.

68 **E. tenax** Linne. The "drone fly." Cosmopolitan, everywhere abundant from early spring to late autumn.

69 **E. transversus** Wiedemann. Numerous specimens, Lakeville, Columbus, Sandusky, Ira, Wauseon; first of April and last of August.

### **Meromacrus** Rondani

70 **M. acutus** Fab. A male, Cincinnati, Sept. 1, 1909 (Dury). See Journal Cinc. Soc. Nat. Hist. Vol. XXI, p. 62.

### **Tropidia** Meigen

1 Femora black, at the tip testaceous; the hind femora below, near the base, with a strong mammiform process. (*male*) ..... **mamillata* Loew (Ill., Kan., Neb.)

2 Front and middle femora yellow on distal end; hind femora without such process near the base .......................................... **quadrata**

3 Antennae large, reaching nearly to the oral margin, hind coxae of male with a large obtuse spur ................................ **calcarata* Willist (Mich., N. J.)

71 **T. quadrata** Say. One female has a broad, strongly arcuate, black band in the middle of the third segment, well separated from the margins, expanded on the middle line in front. Two females are only about eight millimeters long. Numerous specimens, Sandusky, Columbus, Hinckley, Wauseon; May 23 to Sept. 10. (Figs. 229, 233.)

### **Helophilus** Meigen

1 Face jutting forward into a sharp cone .............................. **conostomus**
Face not conically produced forwards ....................................... 2

2 Sixth longitudinal vein distinctly sinuous; light colored species, stripes of thorax distinct .......................................... 3
Sixth vein nearly straight or only gently curved; antennae reddish-yellow ... 4

3 Front of female black pilose; front of male narrow above ............... **similis**
Front of female black pilose only near the ocelli; front of male broad .... **latifrons**

4 Abdomen elongate, cylindrical in the male ................................ 8
Abdomen oval; face yellow; dorsum of thorax with distinct light colored stripes ........................................................ 5

5 Third abdominal segment, except a small opaque spot in front, and the fourth, shining sub-metallic black ................................ **bilinearis**
Third and fourth segments distinctly banded ................................ 6

6 Hind femora yellow in the middle, abdomen predominately yellow ... **flavifacies?**
Hind femora in large part black above; luteous fasciae of the abdomen broad, the first narrowly interrupted, the remainder entire ................................ **integer* Loew (N. Y. N., J.)
Hind femora with a black ring at the middle ................................ 7

7 Arista wholly black; yellow of each of the principal abdominal segments divided into two moderately curved lunules ................................ **divisus**
Arista black at the tip; abdomen with much yellow ........................ **laetus**

8 Hind coxae of the male with a stout process below .... .........**chrysostomus**
Hind coxae of the male not with a stout process.................................
................................*distinctus* Willst. (Conn., Va., Pa., N. J.)

72 **H. bilinearis** Williston. Five males, Columbus; April 28 to May 2.

73 **H. chrysostomus** Wiedeman. Five males and two females, Danville, Medina, Sandusky; June 10 to July 12.

74 **H. conostomus** Williston. Fourteen specimens, males and females; Sandusky, Columbus, Hinckley; May 2 to July 20.

75 **H. divisus** Loew. One male and one female, Sandusky, Kent, mid-June and early July.

76 **H. flavifacies?** Bigot. I place here with some question, two males, Medina, and Sandusky; July.

77 **H. laetus** Loew. One male, Columbus, mid-May; 30 specimens, males and females, Sandusky, May 30 to August 21.

78 **H. latifrons** Loew. Fifteen specimens, males and females, Columbus, Lakeville, Sandusky, Ira, Vinton; April 1 to October 20.

79 **H. similis** Macquart. 25 specimens, males and females, Columbus, Lakeville, Wauseon, Georgesville, Cleveland, Jefferson, Ira; March 29 to October 22. (Figs. 218, 219, 246.)

## **Mallota** Meigen

1 Eyes pilose; more or less of the base of the abdomen with yellow pile
.............................................................**posticata**
Eyes bare ............................................................ 2

2 Eyes contiguous in the male; abdomen almost wholly black pilose; hind tibiae of the male with a stout spur in the middle (form *Bautius*) or wholly without such spur ..........................................**cimbiciformis**
Eyes separated in the male; front of female broader than in *M. posticata* and *cimbiciformis*..................................*illinoisensis* Robertson (Ill.)

80 **Mallota cimbiciformis** Fallen. Three males all of form *Bautius*, four females smaller; Hinckley, Medina, Sandusky; mid-June to Aug. 8.

81 **M. posticata** Fabricius. Eight specimens, Hinckley, Wauseon, Sandusky, Ira; last of May to last of August.

## **Triodonta** Williston

82 **T. curvipes** Wiedemann. Two males, one female, Castalia; mid-July.

## **Teuchocnemis** Osten Sacken

**T. lituratus* Loew. (Pa., Conn., Mo., Quebec.)

## **Pterallastes** Loew.

83 **P. thoracicus** Loew. Eight males and one female, Hinckley, Ira, Ft. Ancient, Cincinnati (Dury); June 10 to late August.

## **Senogaster** Macquart

*S. *comstocki* Willst. (N. Y.)

## **Syritta** St. Fargeau and Serville

84 **S. pipiens** Linne. Abundant; specimens from Lakeville, Columbus, Medina, Sandusky, Wauseon; early May to early October. The males have an area of enlarged facets above. One female has front all black, mostly shining; the face also dark brown. (Figs. 232, 234.)

## **Xylota** Meigen

1 Legs wholly black; hind femora much thickened ........................ 2
Legs not wholly black ........................ 3
2 Wholly black; wings black ........................ **chalybea**
Abdomen chiefly red; the second segment with a basal black triangle; wings nearly hyaline ........................ **pigra**
3 Second and third abdominal segments (at least) red ........................ 4
Second and third segments wholly black, or with yellow spots ........................ 6
4 Abdomen wholly red except the first segment; hind coxae of the male without a tooth below ........................ **bicolor* Loew (Ill., Pa., N. J.)
Abdomen except the first segment, not wholly red ........................ 5
5 Second abdominal segment with a basal black triangle; the 2-4 segments with narrow lateral black margins ........................ **marginalis**
Abdomen not so marked; hind coxae of male with a spur below ........................ **flavitibia* Bigot (Cal., Col., Nebr., D. C., N. M.)
6 Front and middle legs and a large part of the hind femora yellow; large species; coxae black ........................ **curvipes* Loew (N. H., N. Y., Minn., Cal.,)
Front legs in large part black ........................ 7
7 Abdomen, long, slender, with two distinct yellow spots on the second segment ........................ **angustiventris**
Abdomen not unusually slender ........................ 8
8 Abdomen with two pairs of yellow spots ........................ 10
Abdomen wholly black ........................ 9
9 Third joint of antennae but little longer than broad, subquadrate, reddish-brown; the two basal joints black; arista luteous at the base ........................ **anthreas**
Third joint large, much longer than broad ........................ **elongata**
10 Hind femora much thickened, smaller species; arista yellow at the base ........................ **fraudulosa**
Hind femora moderately thickened ........................ 11

11 Fourth abdominal segment brilliant bronze; third longitudinal vein gently curved; arista wholly luteous ....... .............................. **analis**
Fourth abdominal segment black; third vein quite straight; arista wholly black ........................................................ **ejuncida**

85 **X. analis** Williston. One male, Sandusky; July 7.

86 **X. anthreas**? Walker. One male, Columbus, May 10, seems to fit very closely Williston's description for the female except that the pile of the thoracic dorsum is erect, not appressed.

87 **X. angustiventris** Loew. Three males, Hinckley, London; late May to early August.

88 **X. chalybea** Wiedemann. Four males, Medina, Columbus, Cincinnati; mid-May to early August.

89 **X. ejuncida** Say. Abundant, Ira, Hinckley, Columbus, Cincinnati; mid-May to mid-August. Majority of specimens males.

**X. elongata** Williston. Considered a synonym of *angustiventris* (Aldrich). Three females, Hinckley, Waterloo, Ashtabula; early June to early August.

90 **X. fraudulosa** Loew. Six males, three females, Cincinnati, Columbus, Lockbourne, Sandusky; early May to mid-July.

91 **X. marginalis** Williston. One female, Cincinnati, May 3.

92 **X. pigra** Fabricius. Taken by Dury at Cincinnati, May 14, 1906, and June 26, 1904.

## **Chrysochlamys** Rondani

1 Hind border of the second and third abdominal segments black, opaque; arista reddish .......... ............................................ 2
2 Face in the middle with a V-shaped black spot; legs reddish-yellow ..... **dives**
Facial spot indistinct in outline; front femora at the base and the tip of all the tarsi black .................................. **buccata* Loew, female (Va.)

93 **C. dives** Osten Sacken. Two females, Medina, Sandusky; late June, early July.

## **Brachypalpus** Macquart

1 Hind femora with short bristles below; abdomen with brilliant metallic cross-bands (*Calliprobola*): dorsum of thorax yellow pilose, ...... . .........
................ ........................ **sorosis* Willst. (Ga., N. J.)
Hind femora not with bristles below; abdomen uniformly black ............ 2
2 Legs wholly black: abdomen uniform black ...................... .... **rileyi**
Legs in part yellow; hind femora toward the end, the hind tibiae before the middle and at the lower end, spurred in the male; length 10 mm. or more
.... .... ........... ...................... .......... .... **frontosus**

94 **B. frontosus** Loew. One male, London, April 19.

95 **B. rileyi** Williston. Two males, one female, Columbus, Cincinnati; April 21 to May 6.

## **Merapioidus** Bigot

96 **M. villosus** Bigot. One female, Hinckley, two females, Lakeville, April 1 (on *Salix*). (Figs. 225, 226.)

## **Crioprora** Osten Sacken

**C. cyanogaster* Loew (Pa., Col., Montreal.)

## **Criorhina** Meigen

Face produced downwards and forwards; males dichoptic; ground color black, thickly pilose.......................Sub-genus *Criorhina*

Face produced downwards, convex below; males holoptic, ground color with yellow markings, moderately pilose ..................... ............................Sub-genus *Cynorhina* Williston

Face produced downwards, convex below; eyes dichoptic, moderately pilose, in large part yellow.......... Sub-genus *Somula* Macquart

## **Criorhina**

97 **C. verbosa** Walker. 12 specimens, Lakeville, March 31, April 1; one, Ira, March 29.

## (**Cynorhina**)

1 Face without yellow produced somewhat forwards below; second segment of abdomen broadly and third and fourth narrowly on the sides, yellow....... ........................................................ **umbratilis**

Face in large part yellow....................................................... 2

2 Face with a median shining black stripe; second segment of the abdomen on the sides, continued more narrowly on the third, yellow..........**intersistens**

Face yellow. Without a median black stripe..................................... 3

3 Front of female wholly yellow; abdomen black except a large part of fourth and the whole of the fifth segments, which are bright orange yellow ..........................................**analis* Macq. (N. J. Can. L. I.)

Front of female black on upper part.............................................. 4

4 Abdomen with two to four pairs of yellow side-spots touching the lateral margins.......................................... **notata* Wied (Ga., Car.)

Abdomen with yellow markings as follows: sides of first segment, an interrupted or sub-interrupted anterior fascia on second segment expanded in the middle, and the remainder of the segments especially the fourth with a narrow posterior margin; elsewhere black shining..............**pictipes?**

98 **C.** (*Cynorhina*) **intersistens.** Walker. Two males, Cincinnati, Vinton; mid-May and early June.

99 **C.** (*Cynorhina*) **pictipes?** Bigot. Two males and one female, Ft. Ancient and West Jefferson early June, correspond fairly with my translation of Bigot's description.

100 **C.** (*Cynorhina*) **umbratilis** Williston. One male Ohio, May 22, 1901.

### (**Somula**)

101 **C.** (*Somula*) **decora** Macquart. One male, two females. Hanging Rock, Vinton, Flint; mid-May to early June.

### **Milesia** Latreille.

102 **M. virginiensis** Drury. (*ornata* Fabricius). Numerous specimens of this magnificent species, Sandusky, Ira, Akron, Wauseon, Vinton, Hinckley, Portsmouth; June to early September. (Figs. 231, 237.)

### **Spilomyia** Meigen.

1 Second joint of antennae much longer than the first (x 1.75); second segment of the abdomen with a broad arcuate yellow band, the third and fourth with a slender median one .................. .................**quadrifasciata**

Second joint of the antennae not much longer than the first; abdomen not so marked.......................................................... 2

2 Abdomen yellow; first segment, except the lateral angles, black, each of the following segments with two narrow black bands, the one on the anterior margin entire, the others interrupted............. ...............**hamifera**

Abdomen black with yellow cross bands.................... ............ 3

3 First and second abdominal segments wholly black, third with a posterior cross band, fourth with two, the anterior one interrupted; abdomen broadly oval,...... .......... ..........................................**fusca**

First segment with a yellow side spot, the following each with two cross-bands, the first cross-band entire, the third and fifth may be very narrowly interrupted, not dilated on the sides...............................**longicornis**

103 **S. fusca** Loew. One male, two females, Hinckley, Ira, early August.

104 **S. hamifera** Loew. Five specimens, Hinckley, Ft. Ancient; early June and August 1. (Fig. 228.)

105 **S. longicornis** Loew. Fifteen specimens, Blendon, Hinckley, Wauseon, Medina, Sandusky; July 10 to September 11.

106 **S. quadrifasciata** Say. Fifteen specimens, Wauseon, Blendon, Jefferson; August 28 to September 11.

## **Sphecomyia** Latreille

107 **S. vittata** Wiedemann. One male, one female, West Jefferson; mid-May and early June. (Figs. 236, 239.)

## **Temnostoma** St. Fargeau and Serville

1 Abdomen with three or four yellow pollinose cross-bands of nearly equal width .................................................. **bombylans**
Abdomen of female has only three yellow pollinose cross-bands; the wings brown in front, this color not extending behind the fourth longitudinal vein; otherwise close to *bombylans* ................ **trifasciata* Robertson (Ill.)
Abdomen broadly oval, with more than four cross-bands, of unequal width.. 2
2 The thorax has, in addition to the other spots, two on each side made by the interruption of the sutural stripe ..................................... 4
The thorax has, in addition to the other spots, only one elongate spot on each side; femora mostly yellow; distal part of abdomen with broad yellow and very narrow black cross-bands ..................................... 3
3 Scutellum except the base, densely yellow pollinose ............... **pictulum**
Sculletum, except the base, shining metallic.................... **excentricum**
4 Second segment of abdomen with a broad anterior cross-band, distal segments with three transverse black spots.................................**alternans**
Second segment without anterior cross-band, distal segments with a broad interrupted black cross-band; pile of scutellum black....................
..........................**venusta* Willst. (Lake Superior, Mass., N. H )

108 **T. alternans** Loew. Seven specimens, Ira, Medina; June 10 to August 15.

109 **T. bombylans** Fabricius. Six males and two females, Ira, Columbus, Cincinnati; mid-May to mid-June.

110 **T. excentrica** Harris. Seven specimens, Ira, Cincinnati; June. (Fig. 235.)

111 **T. pictula** Williston. Four specimens, Cincinnati; early June.

## **Ceria** Fabricius (*Ceriodes*)

Antennal process almost wholly wanting, first joint of antennae very slender, nearly as long as the two following together; face vertical not at all excavated in profile; second segment of the abdomen much constricted, third and fourth segments each with two arcuated spots....................................... **willistoni**

Antennal process slender, longer than first joint of antennae; second to fourth abdominal segments without yellow spots in addition to bands of hind margin; second segment much shorter than the third; third longitudinal vein bent deeply into first posterior cell..................................................**abbreviata**

112. **C. abbreviata** Loew. Six specimens, Lakeville et. al. loc. June 15 and 27.

113. **C. willistoni** Kahl. Three taken by Dury at Cincinnati, May 22.
**Ceria signifera* Loew, (a bred specimen, Pa.).
(*Ceria signifera* Loew of Williston, Synop. N. A. Syrph. p. 264=*C. willistoni*.)

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# PLATES AND EXPLANATIONS

# EXPLANATION OF PLATE I.

*Didea fasciata fuscipes* Loew

Fig. 1 Adult female x 6.

Fig. 2 Larva about six times natural size; a, anterior spiracle; b, caudal spiracles.

Fig. 3 Antero-ventral view of head and mouth-parts of larva, enlarged; a, upper jaw with a small pair of hooklets at the side; b, lower jaw; c and d, lateral hooklets; e, antennae; f, sense papillae.

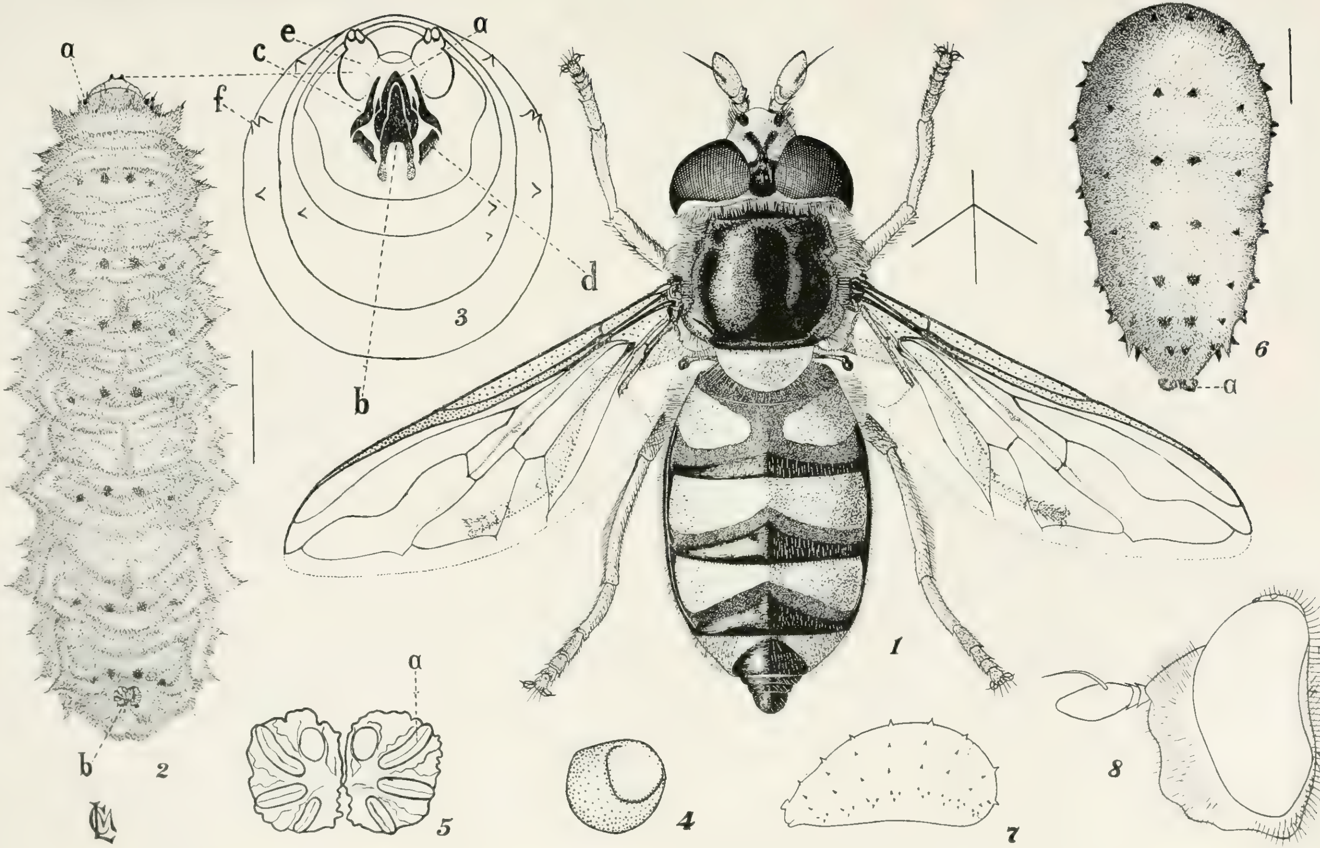
Fig. 4 Right anterior spiracle much magnified.

Fig. 5 Posterior breathing organs enlarged; a, one of the radiating spiracles.

Fig. 6 Dorsal view of puparium a little more than five times natural size; a, caudal spiracles.

Fig. 7 Puparium from the side showing arrangement of spines and line of cleavage for escape of adult.

Fig. 8 Head of male in profile.

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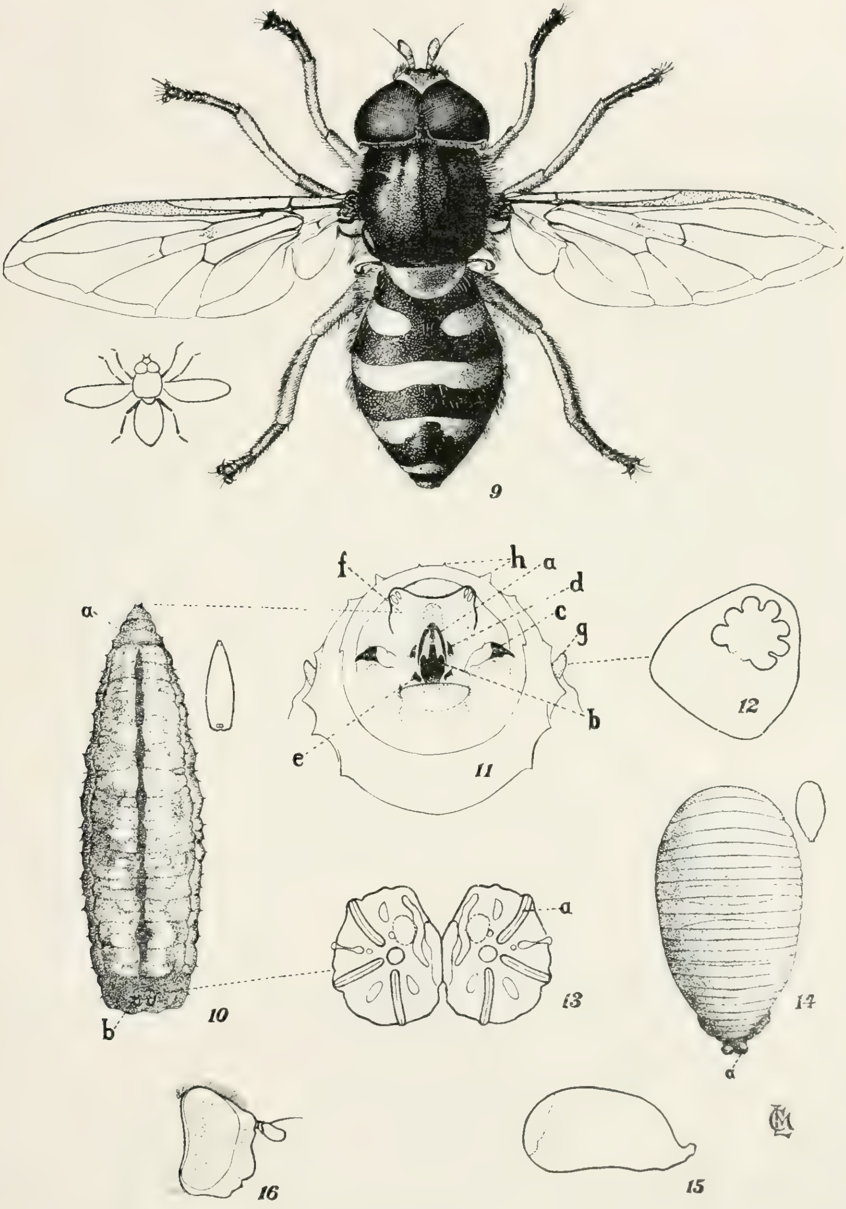
## EXPLANATION OF PLATE II.

*Syrphus torvus* Loew

Fig. 9 Adult male, natural size and enlarged.
Fig. 10 Larva, natural size and enlarged; a, anterior spiracle; b, posterior spiracle.
Fig. 11 Antero-ventral view of head and mouth-parts much enlarged; a and b, upper and lower jaws partially separated; c, outer pair of mouth hooks; d and e, two inner pairs of mouth-hooklets; f, antennae; g. anterior spiracle; h, sense papillae.
Fig. 12 Anterior spiracle of larva highly magnified.
Fig. 13 Posterior breathing appendages much enlarged; a, one of the six caudal spiracles.
Fig. 14 Puparium from above, natural size and enlarged; a, posterior spiracles.
Fig. 15 Puparium from side showing line of clea vage for escpe of adult.
Fig. 16 Head of female in profile.

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# EXPLANATION OF PLATE III.

## Figures 21-30 *Paragus bicolor* (Fab.)

Fig. 21 Mature larva x 10; a, antennae; b, anterior spiracle; c, posterior respiratory organ.

Fig. 22 A segmental spine of the larva x 40.

Fig. 23 Antero-lateral view of mouth-parts of larva, much enlarged; a, outer pair of mouth-hooks; b, broad chitinous plates surrounding the esophagus; c, antennae; d, upper jaw; e, three pairs of lateral mouth-hooks; f, lower jaw.

Fig. 24 Right anterior spiracle highly magnified.

Fig. 25 Dorsal view of posterior respiratory organ x 60; a, the dorsal spine; b, one of the radiating spiracles.

Fig. 26 End view of posterior respiratory organ x 70; a, its dorsal spine; b, a spiracle; c, the circular plate.

Fig. 27 Dorsal view of puparium x 5; a, posterior respiratory organ; b, median segmental spine of sixth larval segment; c, dorsal and d, dorso-lateral spines of sixth and seventh larval segments, respectively.

Fig. 28 Lateral view of puparium x 5; a, posterior respiratory organ; b, median spine; d, dorso-lateral spine; e, lateral spine; f, posterior ventro-lateral; and g, anterior ventro-lateral.

Fig. 29 Adult male about seven times natural size.

Fig. 30 Front view of head of female x 12.

## Figures 31-38 *Paragus tibialis* Fallen.

Fig. 31 Posterior part of a young larva from the side greatly enlarged.

Fig. 32 Segmental spine of a full grown larva x 40.

Fig. 33 Dorsal view of posterior respiratory organ of larva x 60; a, the dorsal spine; b, one of the paired radiating spiracles.

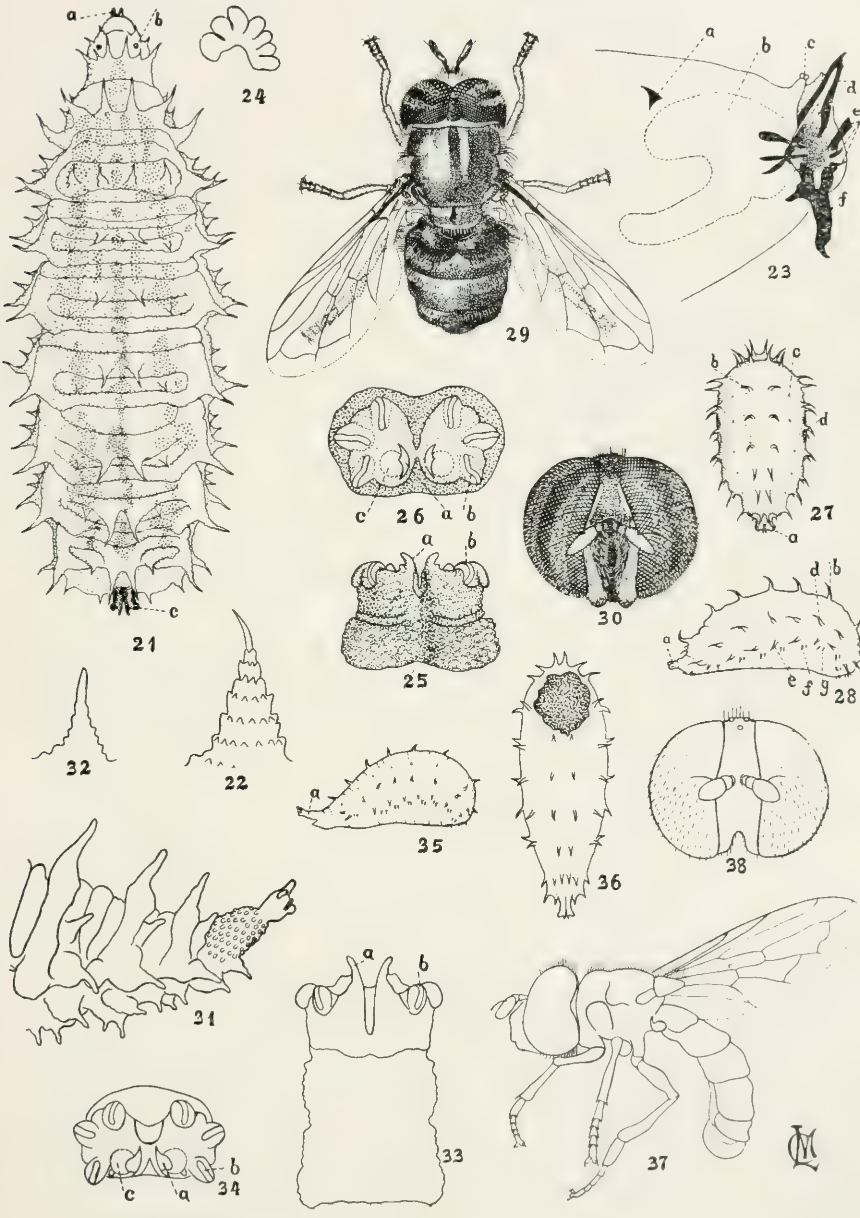
Fig. 34 End view of posterior respiratory organ x 60; a, its dorsal spine; b, a spiracle; c, the circular plate.

Fig. 35 Lateral view of puparium x 5; a, posterior respiratory organ.

Fig. 36 Puparium which has been parasitized by hymenopteron, *Bassus laetatorius* showing typical form and the irregular hole thru which the parasite has escaped.

Fig. 37 Outline drawing of adult male from the side x 8.

Fig. 38 Head of female x 12.

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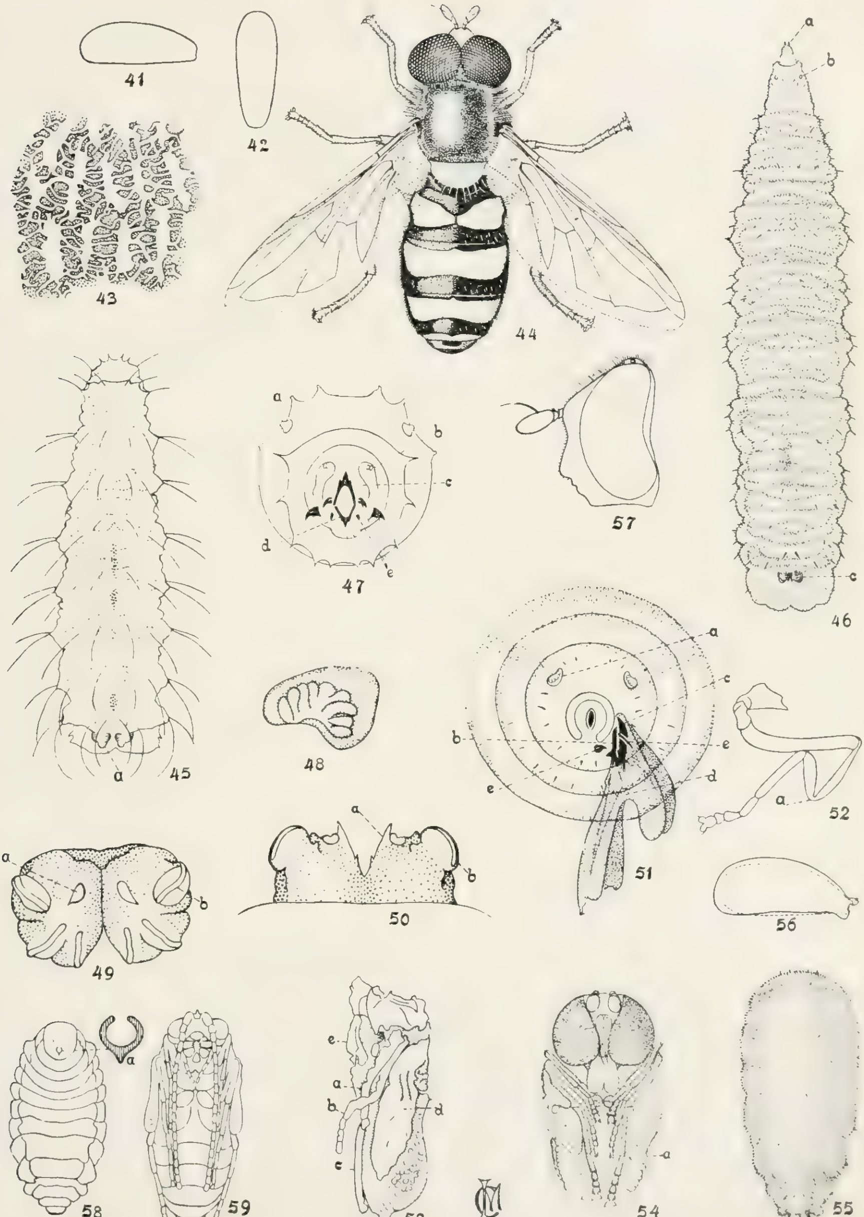
## EXPLANATION OF PLATE IV.

*Syrphus americanus* Wied.

Fig. 41 Egg from the side x 17.
Fig. 42 Dorsal view of egg x 17.
Fig. 43 A small part of the surface of egg-shell showing sculpturing, highly magnified.
Fig. 44 Adult male about 5 times natural size.
Fig 45 Larva just hatched x 59; a, posterior respiratory appendage.
Fig. 46 Full-grown larva x 7; a, antennae; b, anterior spiracle; c, posterior respiratory appendage.
Fig. 47 Anterior view of larva, much enlarged, showing mouth-parts, antennae etc.; a, right anterior spiracle; b, antennae; c, upper jaw; d, lower jaw; e, the three pairs of mouth-hooks.
Fig. 48 Dorsal view of right anterior spiracle, highly magnified.
Fig. 49 End or posterior view of posterior respiratory organ x 55; a, dorsal spiracular spine; b, one of the three pairs of slit-like spiracles.
Fig. 50 Side or dorsal view of posterior respiratory organ x 55; lettering as in Fig. 49.
Fig. 51 Appearance of a part of the puparium externally in the region of the mouth-parts much enlarged; a, right anterior spiracle with short piece of trachea attached; b, lower jaw of larva; c, upper jaw of larva; d, chitinous esophageal framework; e, mouth-hooks of larva.
Fig. 52 Hind leg of pupa showing flexure of tibiae at a.
Fig 53 An early pupal stage from the side; a, b, and c, developing legs; d, wing-pad; e, mouth-parts.
Fig. 54 A much later pupal stage, ventral view; a, the delicate investing membrane.
Fig. 55 Dorsal view of puparium x 5; a, posterior respiratory organ.
Fig. 56 Outline of puparium from the side. The dotted outline is given to show the typical shape of a parasitized puparium.
Fig. 57 Lateral view of head of female x 7.
Fig. 58 Larva of parasite, *Bassus laetatorius*, mouth-parts at a, ventral view.
Fig. 59 Pupa of *B. laetatorius*, ventral view.

Figs. 53, 54, 58, and 59 each about 5 times natural size.

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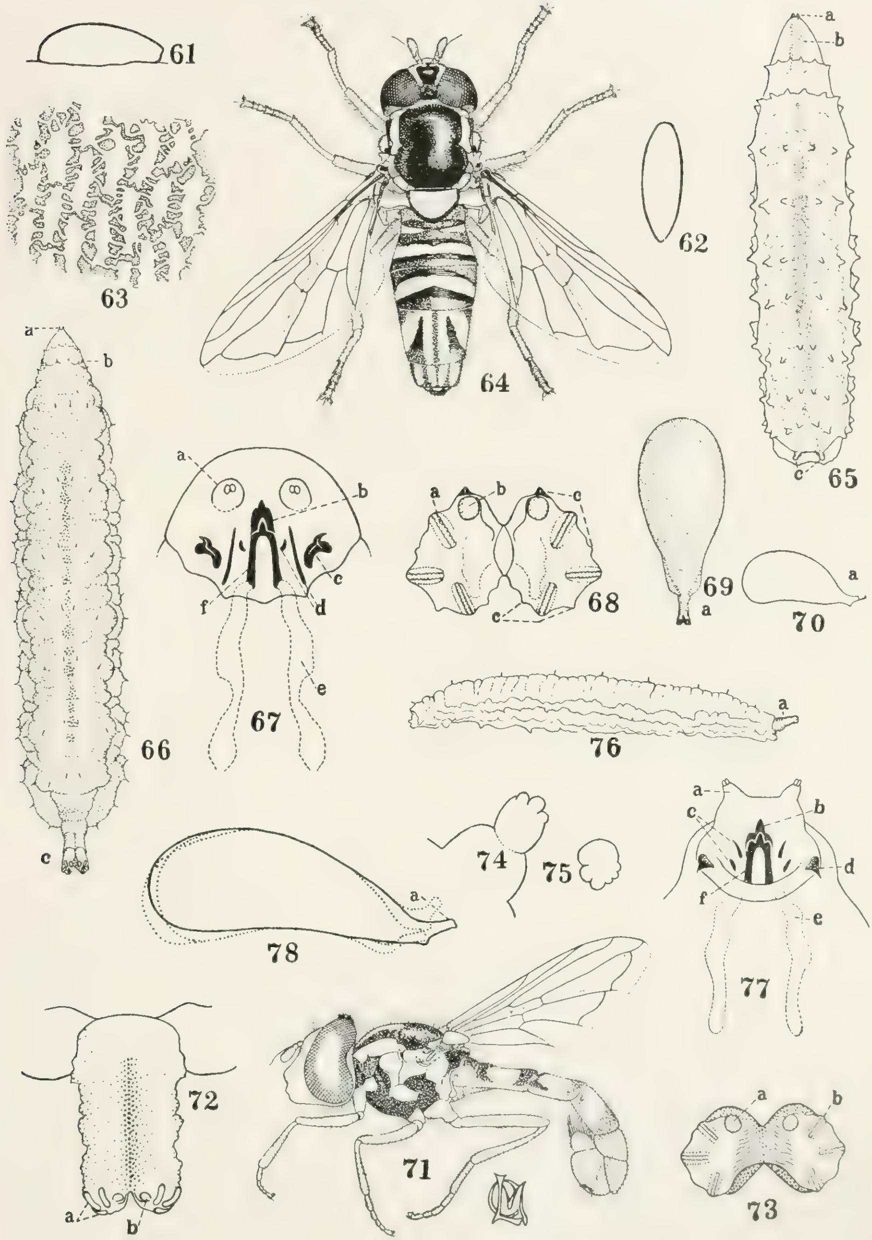
## EXPLANATION OF PLATE V.

Figures 61-70 *Allograpta obliqua* (Say)

Fig. 61 Egg x 20, from the side.
Fig, 62 Dorsal view of egg x 20.
Fig. 63 The sculpturing of the egg-shell, highly magnified.
Fig. 64 Adult female x 7.
Fig. 65 Young larva just hatched, x 50 ; a, antennae; b, internal esophageal framework; c, the posterior respiratory tubes.
Fig. 66 Mature larva x 9; a, antennae ; b, position of anterior spiracles; c, posterior respiratory tubes.
Fig. 67 Antero-ventral view of head of larva much enlarged; a, antennae; b, upper jaw; c, outer pair of mouth-hooks; d, lateral mouth-hooklets; e, internal esophageal framework; f, lower jaw.
Fig. 68 End view of posterior respiratory appendage; a, one of the spiracles; b, the circular plate; c, the interspiracular spines.
Fig. 69 Dorsal view of puparium x 5; a, posterior respiratory appendage.
Fig. 70 Lateral view of puparium x 3; a, posterior respiratory appendage.

Figures 71-78 *Sphaerophoria cylindrica* (Say)

Fig. 71 Adult male from the side x 7.
Fig. 72 Dorsal view of posterior respiratory appendage; a, spiracles; b, circular plate.
Fig. 73 End view of posterior respiratory appendage; a, circular plate; b, one of the three pairs of spiracles.
Fig. 74 Anterior larval respiratory cornua with spiracles from the side, highly magnified.
Fig. 75 End view of the same.
Fig. 76 Mature larva from the side x 6; a, posterior respiratory appendage.
Fig. 77 Ventral view of head of larva much enlarged; a, antennae; b, upper jaw; c, lateral mouth-hooklets; d, the outer pair of mouth hooks; e, esophageal framework; f, lower jaw,
Fig. 78 Lateral view of puparium x 7; a, the posterior respiratory appendage; the dotted lines represent other shapes in which the pupal envelope may indurate.

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## EXPLANATION OF PLATE VI.

### Figures 81-87 *Syrphus xanthostoma* Wills.

Fig. 81 Antero-ventral view of head of larva much enlarged; a, sensory papillae; b, antennae; c, upper jaw; d, outer pair of mouth-hooks; e, lateral mouth-hooklets; f, lower jaw; g, anterior spiracles or larval respiratory cornua; h, esophageal framework.

Fig. 82 Lateral view of larva x 6; a, median segmental spines; b, posterior respiratory appendage.

Fig. 83 End view of anterior spiracle highly magnified.

Fig. 84 Dorsal view of posterior respiratory organ x 40; a, one of three pairs of slit-like spiracles; b, one of the inter-spiracular spurs; c, the median dorsal spiracular spur; d, the circular plate.

Fig. 85 End view of posterior respiratory organ, x 50; lettering as in Fig. 84.

Fig. 86 Dorsal view of puparium x 3; a, posterior respiratory appendage.

Fig. 87 Lateral view of puparium x 3

### Figures 91-95 The Cock's-Comb-Gall Syrphus Fly.

Fig. 91 Ventral view of head of larva, much enlarged; a, outer pair of mouth-hooks b, upper jaw; c, antennae; d, lateral mouth-hooklets; e, anterior spiracles or larval respiratory cornua; f, esophageal framework; g, lower jaw.

Fig. 92 End view of anterior spiracle, highly magnified.

Fig. 93 Side view of larval respiratory cornua, much magnified.

Fig. 94 End view of posterior respiratory appendage x 40; a, one of the spiracles; b, circular plate; c, one of the inter spiracular hairs.

Fig. 95 The posterior end of the larva from above x 6; a, the posterior respiratory appendage.

### Figures 101-103 *Platychirus quadratus* (Say.)

Fig. 101 Puparium from the side x 4.

Fig. 102 Posterior respiratory appendage as it appears in the pupal stage, end view; a, spiracle; b, circular plate; c, inter-spiracular spur.

Fig. 103 Postero-dorsal view of the posterior respiratory appendage. Lettering as in Fig. 102.

### Figures 111-115 *Chalcomyia aerea* (Loew.)

Fig. 111 Lateral view of puparium x 4; a, anterior larval respiratory cornua; b, pupal respiratory cornua; c, posterior respiratory appendage; d, the anal flabellae; e, one of the seven pairs of pro-legs.

Fig. 112 End view of anterior larval respiratory appendage much enlarged.

Fig. 113 Side view of the same.

Fig. 114 Pupal respiratory cornua from the side much enlarged.

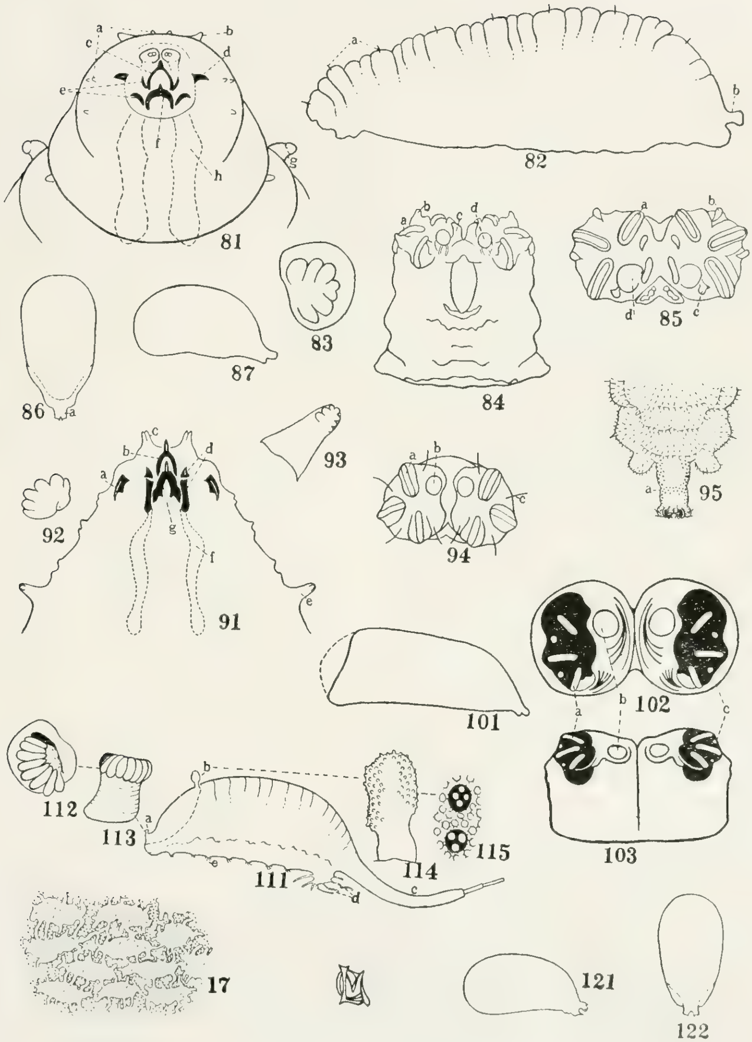
Fig. 115 Two of the numerous tubercles (spiracles) of the pupal cornua highly magnified.

### Figures 121, 122, *Syrphus sp.*

Fig. 121 Lateral view of puparium x 2.5.

Fig. 122 Dorsal view of puparium x 2.5.

Fig. 17 Sculpturing on egg shell of *Didea fasciata fuscipes*.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# EXPLANATION OF PLATE VII.

Figures 142-144 inclusive, *Eristalis tenax* (Linne); all the others from *Eristalis aeneus* (Fabricius),

Fig. 131 Dorsal view of mature larva x 9; a, antennae; b, anterior larval respiratory cornua; c, the large tracheal trunks; d, the posterior respiratory tube or "rat-tail." To avoid confusion the vestiture is not represented in this figure.

Fig. 132 The anterior larval respiratory cornua, much enlarged, dissected out to show the large trachea leading from it.

Fig. 133 Distal end of respiratory tube highly magnified showing wrinkling on outside, the two inner trachea (a) the spiracles at the tip (b) and the delicate feather-like (interspiracular?) appendages (c).

Fig. 134 A small area of the basal segment of the tube much enlarged, showing the nature of the vestiture and wrinkling.

Fig. 135 A small area of the median segment of the tube much enlarged to show the nature of the vestiture and wrinkling.

Fig. 136 A, one of the bifid (segmental?) hairs of the larva, and b, one of the integumental hairs of the body, drawn to the same scale as Figs. 134 and 135.

Fig. 137 The anal opening of the larva (a) with the retractile flabellae (b) much enlarged.

Fig. 138 Ventral view of the head of the larva much enlarged; a, antennae; b, mouth hood; c, the first pair of pro-legs.

Fig. 139 Mouth-hood and esophageal framework of larva dissected out and much enlarged.

Fig. 140 The chitinized parts of the esophageal framework from the side; a, mouth-hooklets?; b, outer pair of mouth-hooks?

Fig. 141 The same from the ventral view.

Fig. 142 Three eggs from an egg-mass of *E. tenax*, x 17.

Fig. 143 A small area of the egg-shell to show sculpturing; highly magnified.

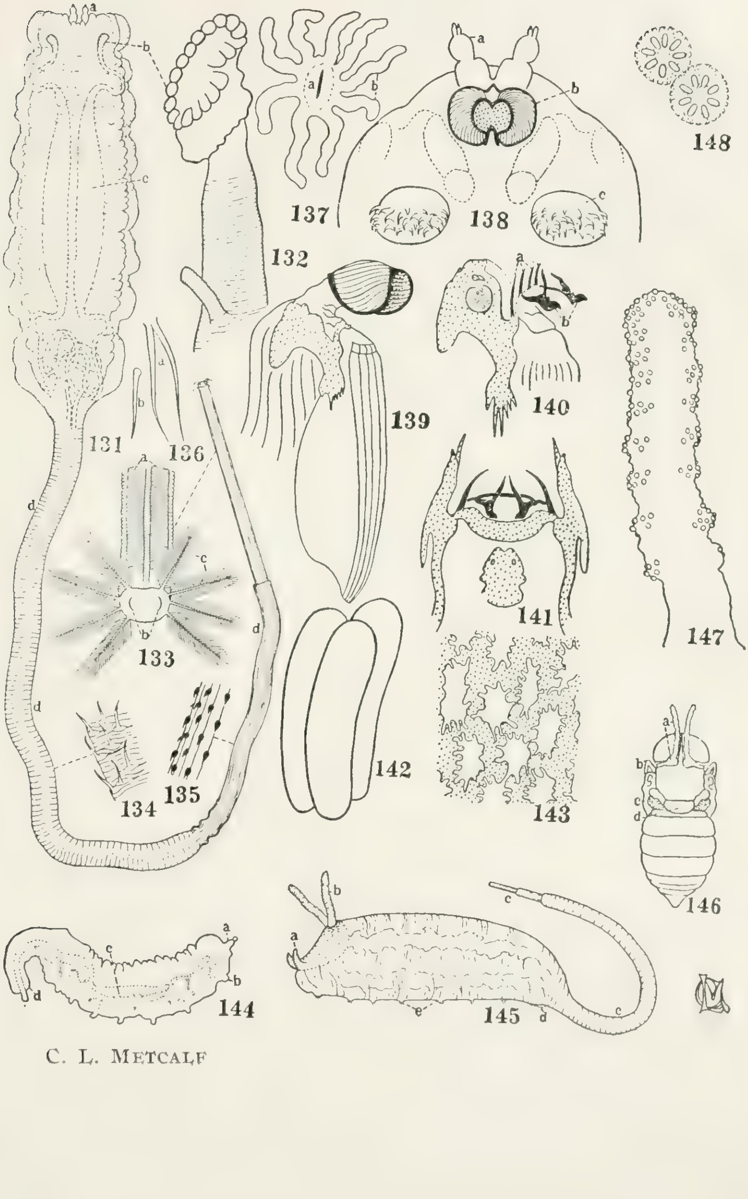
Fig. 144 Lateral view of larva of *E. tenax*, two hours after hatching, x 17; a antennae; b, pro-legs; c, trachea; d, posterior respiratory appendage.

Fig. 145 Lateral view of puparium of *E. aeneus* x 4; a, anterior larval respiratory cornua; b, pupal respiratory cornua; c. posterior respiratory appendage ("rattail"); d, position of anus; e, pro-legs of larva.

Fig. 146 Nymph dissected out from puparium x 3; a, the pupal respiratory cornua, with their internal connections to the prothoracic spiracle of the adult; b, knee of front leg; c, wing-pad; d, scutellum.

Fig. 147 Pupal respiratory cornua much enlarged showing the numerous tubercles.

Fig. 148 Two tubercles of pupal respiratory cornua, highly magnified, showing their radiating elevations (spiracles?).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## EXPLANATION OF PLATE VIII.

*Some Gross Anatomy of Syrphidae.*

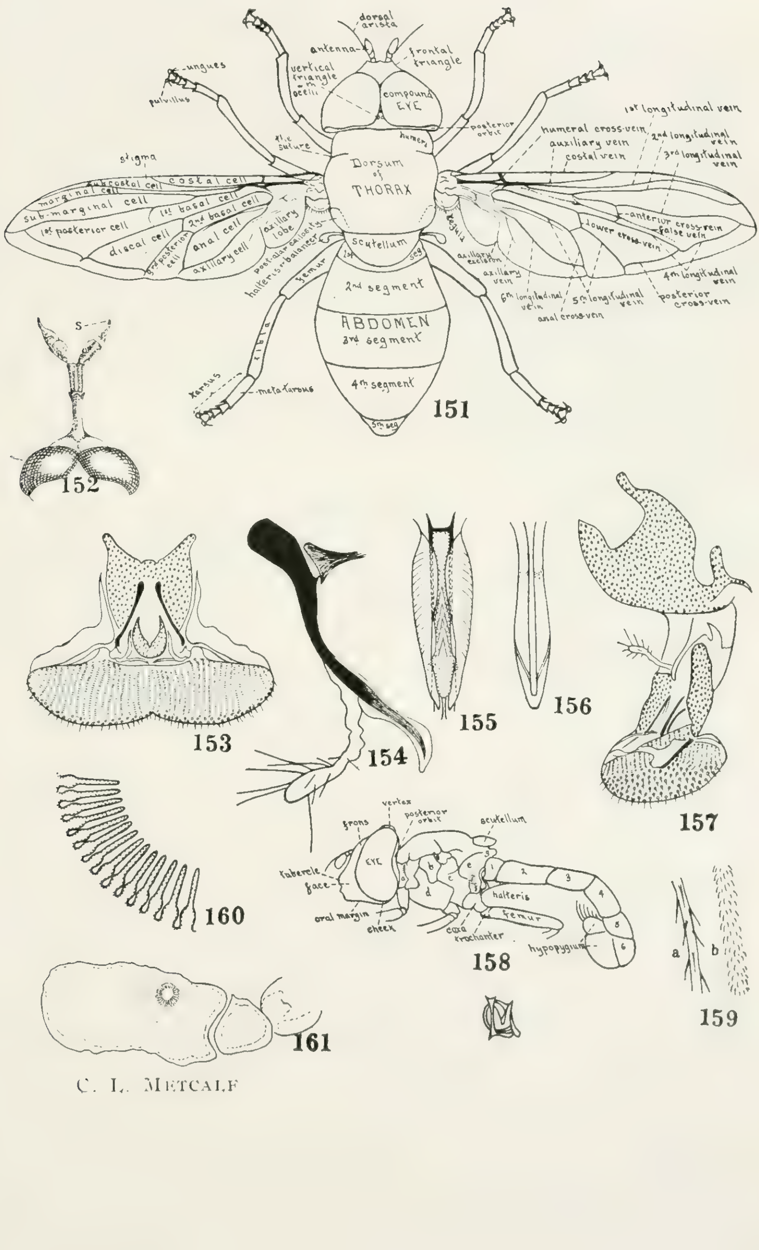
Fig. 151 Dorsal view of male imago(*Syrphus* sp.) with the principal structural features named. The following names of veins are sometimes used instead of those given;

Mediastinal for auxiliary.
Sub-costal for 1st. longitudinal.
Radial for 2nd longitudinal.
Cubital for 3rd longitudinal.
Discal for 4th longitudinal.
Postical for 5th longitudinal.
Anal for 6th longitudinal.
"Vena spuria" for false vein.
Likewise the following names of cells may be used:
Mediastinal for costal.
Cubital for sub-marginal.
Sub-apical for 1st. posterior.
2nd. posterior for discal.
Radial for 1st. or 2nd. basal.

Fig. 152 Dorsal view of head of *Ceria tridens* to show antennae with a terminal style (S).

Figures 153-157 inclusive, mouth-parts of adult *Syrphus americanus.*

Fig. 153 The labium with sides spread showing the inner surface.
Fig. 154 The maxilla; a, maxillary palp; b, maxillary lobe.
Fig. 155 Hypopharynx.
Fig. 156 Labrum.
Fig. 157 Proboscis with parts intact.
Fig. 158 Lateral view of body of *Sphaerophoria cylindrica* with most of appendages removed; a, prothorax with the prothoracic spiracle just above the letter; b, mesopleura; c, pteropleura; d, sternopleura; e, metapleura; f, hypopleura with the metathoracic spiracle directly above the letter. 1-6, abdominal segments.
Fig. 159 Two branched hairs; a, from *Eristalis tenax;* b, from *Eristalis flavipes.*
Fig. 160 Olfactory pit from antenna as it appears in section, showing a few of the perceptory end-organs.
Fig. 161 Outline drawing of median longitudinal section of antenna showing location of olfactory pit.


dorsal arista
antenna
frontal triangle
vertical triangle with ocelli
compound EYE
ungues
pulvillus
posterior orbit
humeri
Dorsum of THORAX
Scutellum
2nd segment
ABDOMEN 3rd segment
4th segment
5th seg
stigma
costal cell
sub-costal cell
marginal cell
sub-marginal cell
1st basal cell
2nd basal cell
1st posterior cell
discal cell
3rd posterior cell
anal cell
axillary cell
axillary lobe
post-alar calosity
halteris or balancer
femur
tibia
tarsus
metatarsus
1st longitudinal vein
humeral cross-vein
auxiliary vein
costal vein
2nd longitudinal vein
3rd longitudinal vein
anterior cross-vein
false vein
lower cross-vein
axillary excision
axillary vein
4th longitudinal vein
6th longitudinal vein
5th longitudinal vein
posterior cross-vein
anal cross-vein
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frons
vertex
posterior orbit
scutellum
tubercle
face
EYE
oral margin
cheek
halteris
femur
coxa
trochanter
hypopygium
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b
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## EXPLANATION OF PLATE IX.

### Figures 181, 182, *Microdon* sp.

Fig. 181 Ventral view of anterior end of larva of *Microdon* sp. showing the mouth-parts; *a*, the marginal fringe; *b*, antenna; *c*, mandible-like mouth-hooks; *d*, *e*, the tri-fid lower jaw; very much enlarged.

Fig. 182 A dorsal view of larva of *Microdon* sp. showing general appearance, the marginal fringe, the reticulate ornamentation of the dorsum and the posterior respiratory appendage, x 10.

### Figures 183-187, inclusive, *Microdon tristis*

Fig. 183 Empty puparium of *Microdon tristis* showing general shape and appearance; the orifice through which the adult emerged; the posterior respiratory appendage, etc. x 5.5.

Fig. 184 One half of the posterior respiratory appendage showing the arborescent stigmatic pattern; *a*, the circular plate; x 40.

Fig. 185 Antero-dorsal view of posterior respiratory appendage, x 40.

Fig. 186 Anterior pupal respiratory cornuum, which is pushed off with the operculum; much enlarged showing the tubercles on its surface.

Fig. 187 A small area of the surface of the pupal cornuum, highly magnified; showing the appearance of the tubercle-like spiracles, each with a short piece of its afferent trachea, visible thru the integuments.

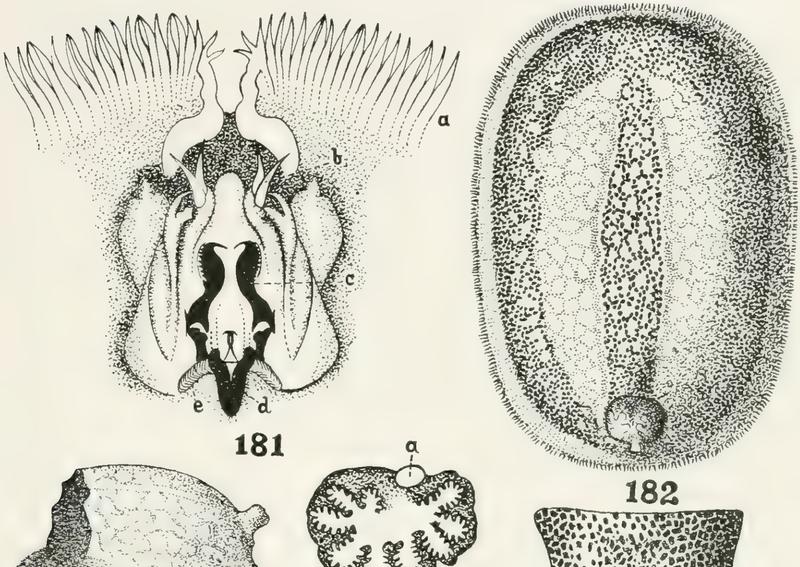
### Figures 191-194, inclusive, *Mesogramma polita*

Fig. 191 The jaws of the larva as dissected from a puparium highly magnified The rest of the mouth-parts could not be determined.

Fig. 192 Lateral view of puparium of *M. polita*, x 10, showing general shape; *a*, the posterior respiratory appendage.

Fig. 193 Antero-dorsal view of posterior respiratory appendage x 75; *a*, the most dorsal of the spiracles which is short, its elevation rounded; *b*, the dorsal spiracular spine.

Fig. 194 End view of the posterior respiratory appendage; magnification and lettering same as in Fig. 193; *c*, *d*, the two more ventral and elongate spiracles.

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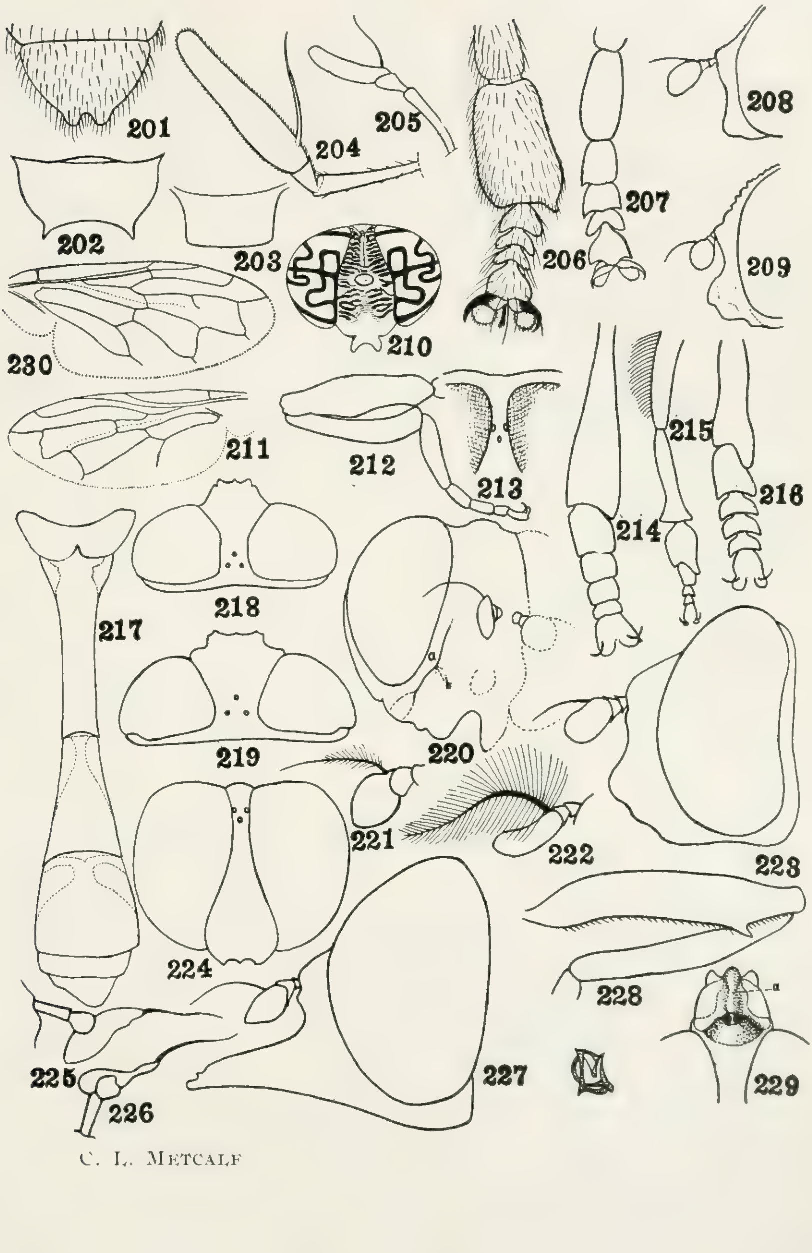
## EXPLANATION OF PLATE X.

Fig. 201 *Microdon fuscipennis*, scutellum, showing the ornamental spines.
Fig. 202 *Microdon tristis*, scutellum, showing the ornamental spines.
Fig. 203 *Chalcomyia aerea*, *female*, large, sub-rectangular scutellum.
Fig. 204 *Microdon fuscipennis*, antenna.
Fig. 205 *Microdon tristis*, antenna.
Fig. 206 *Microdon fuscipennis*, *male*, hind tarsus.
Fig. 207 *Microdon tristis*, *male*, hind tarsus.
Fig. 208 *Pipiza pisticoides*, *female*, face from the side.
Fig. 209 *Chrysogaster nigripes*, *female*, face from the side.
Fig. 210 *Chrysogaster nitida*, *female*, head from in front with antennae removed, showing the wrinkling of front and face and the color markings on the eyes.
Fig. 211 *Chrysogaster pictipennis*, *female*, wing.
Fig. 212 *Chalcomyia aerea*, hind leg showing distinctly thickened femur.
Fig. 213 *Mesogramma geminata*, *female*, vertex and part of the front, showing ocelli remote from the vertex.
Fig. 214 *Platychirus hyperboreus*, *male*, front tibia and tarsus.
Fig. 215 *Platychirus peltatus*, *male*, front femur, tibia and tarsus.
Fig. 216 *Platychirus quadratus*, *male*, front tibia and tarsus.
Fig. 217 *Baccha clavata*, *male*, distinctly clubbed abdomen.
Fig. 218 *Helophilus similis*, *male*, dorsal view of head with antennae removed, showing shape of front in a dichoptic male.
Fig 219 *Helophilus similis*, *female*, dorsal view of head.
Fig. 220 *Chilosia willistonii*, *female*, antero-lateral view of a part of the head to show the orbital groove (b); a, facial orbit.
Fig. 221 *Eristalis flavipes*, *female*, antenna with a pubescent arista.
Fig. 222 *Volucella evecta*, *female*, antenna with a plumose arista.
Fig. 223 *Xanthogramma felix*, *female*, lateral view of head showing the face receding below.
Fig. 224 *Ocyptamus fuscipennis*, *female*, antero-dorsal view of head showing the long front much narrowed above.
Fig. 225 *Merapioidus villosus*, lateral view of antenna, showing the peculiar shape of the third joint.
Fig. 226 Dorsal view of the same.
Fig. 227 *Rhingia nasica*, lateral view of the head showing the long porrect snout.
Fig. 228 *Spilomyia hamifera*, *female*, hind femur and tibia.
Fig. 229 *Tropidia quadrata*, *female*, antero-dorsal view of part of the head showing the carinate protuberant face, antennae removed; a, the carina or longitudinal ridge.
Fig. 230 *Microdon fuscipennis*, wing showing venation; the color pattern is not shown.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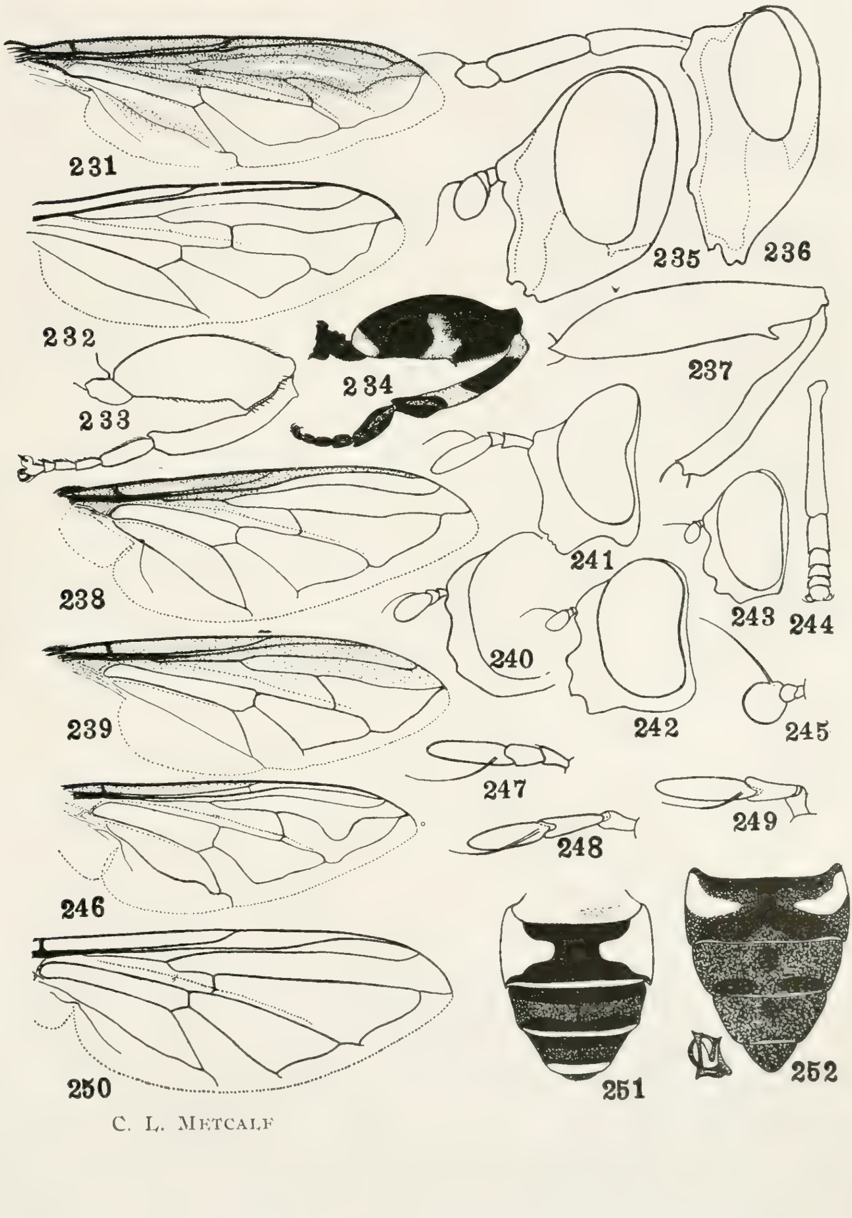
C. L. Metcalf

## EXPLANATION OF PLATE XI.

Fig. 231 *Milesia virginiensis*, wing, showing a closed marginal cell and anterior cross-vein beyond middle of discal cell.
Fig. 232 *Syritta pipiens*, wing.
Fig. 233 *Tropidia quadrata*, hind leg.
Fig. 234 *Syritta pipiens*, hind leg, showing femur extraordinarily thickened and its color markings.
Fig. 235 *Temnostoma excentrica*, *female*, lateral view of head.
Fig. 236 *Sphecomyia vittata*, *female*, lateral view of head.
Fig. 237 *Milesia virginiensis*, *male*, hind femur and tibia.
Fig. 238 *Sericomyia militaris*, wing.
Fig. 239 *Sphecomyia vittata*, wing.
Fig. 240 *Platychirus hyperboreus*, lateral view of head.
Fig. 241 *Chrysotoxum laterale*, *male*, lateral view of head.
Fig. 242 *Platychirus peltatus*, *female*, lateral view of head.
Fig. 243 *Chilosia pallipes*, *male*, head from the side.
Fig. 244 *Platychirus hyperboreus*, *female*, Showing widened front tibia and tarsus characteristic of the genus.
Fig. 245 *Chrysogaster nigripes*, *female*, medial view of antenna.
Fig. 246 *Helophilus similis*, wing.
Fig. 247 *Chrysogaster pulchella*, *female*, dorso-medial view of antenna.
Fig. 248 *Chrysogaster nitida*, *male*, dorsal view of antenna.
Fig. 249 *Chrysogaster pictipennis*, *female*, dorsal view of antenna.
Fig. 250 *Melanostoma obscurum*, *male*, wing.
Fig. 251 *Eristalis temporalis*, *male*, abdomen except the first segment, illustrating the color pattern; the solid black represents the extent of opaque black markings on the specimen; the stippled area represents shining black; the uncolored indicates the yellow or translucent spots or bands.
Fig. 252 *Eristalis dimidiatus*, abdomen showing color pattern; conventions as in Fig. 251.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C. L. METCALF

THE OHIO STATE UNIVERSITY BULLETIN

VOLUME XVIII NUMBER 24

# OHIO BIOLOGICAL SURVEY

## BULLETIN 2

Catalog of

# Ohio Vascular Plants

MARCH, 1914

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Entered as second-class matter November 17, 1905, at the postoffice at Columbus, Ohio, under Act of Congress, July 16, 1894.

# OHIO BIOLOGICAL SURVEY

HERBERT OSBORN, Director

## OHIO STATE UNIVERSITY IN CO-OPERATION WITH OTHER OHIO COLLEGES AND UNIVERSITIES



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VOLUME I BULLETIN 2

# OHIO BIOLOGICAL SURVEY

## CATALOG OF OHIO VASCULAR PLANTS

Arranged according to the phyletic classification; with notes on the geographical distribution in the state, based mainly on specimens in the State Herbarium, Botanical Laboratory, The Ohio State University.

BY

JOHN H. SCHAFFNER, M. A., M. S.

Published by
THE OHIO STATE UNIVERSITY
Columbus
1914

CONTRIBUTION FROM THE BOTANICAL LABORATORY OF THE OHIO STATE UNIVERSITY, No. 83. : : : : :

# PREFACE

This catalog of the vascular plants of Ohio is based on specimens for the most part in the State Herbarium of the Ohio State University, although some records have also been obtained from other collections. The State Herbarium is at present a collection of about 30,000 sheets, and represents the labors of many Ohio botanists. The distribution by counties is in many cases not the known distribution, but it was thought advisable to give only such data as could be verified by specimens. A list* of 254 species and varieties was published with a view to their exclusion from the state catalog if no evidence of their presence in the state were forthcoming. As a result of this publication, numerous records and specimens were obtained. The present catalog contains 2065 numbered species, about one-fourth of which are non-indigenous. Three additional species have been inserted in their proper places since the list was numbered for publication. A considerable number of varieties and supposed hybrids are also included.

"The Fourth State Catalogue of Ohio Plants," by W. A. Kellerman, 1899, was based on specimens in the State Herbarium at that time. However, a large number of species was included for which there was no direct evidence. Most of these, together with some species wrongly identified, have been omitted. A large list of contributors of specimens from various parts of the state was published in the "Fourth Catalogue." Many of these have greatly increased their collections in the State Herbarium and a number of other botanists have sent important specimens.

The species in the State Herbarium have been carefully determined, in the more difficult groups by the best experts in the country, and it is believed that there are few mistakes in the list as now published. Any errors, however, can be definitely corrected in the future. Several species became uncertain through the shifting of names and have been omitted until more and better material can be studied.

The species are numbered serially, and the varieties, forms, and supposed hybrids are indicated by letters. Additions of species will

*Plants on the Ohio State list not represented in the State Herbarium. Ohio Nat. 9: 413-415.

be made by means of the decimal system. For example, if a new species is to be added after No. 1866, it will be numbered 1866.1. Additions will only be made on the basis of good herbarium specimens. It is much better to have a small, reliable list than a large one with many doubtful entries. The introduced species have been designated by some phrase by which they can be distinguished from the indigenous species.

The nomenclature used is that of Britton and Brown's "An Illustrated Flora of the Northern United States, Canada, and the British Possessions," second edition. The few names which differ because of a different conception of the genus will cause no special trouble in reference. "Kellerman's Fourth State Catalogue of Ohio Plants" was based on the first edition of the "Illustrated Flora," and thus the names following the "American Code" on the principle of priority have been used very generally in Ohio since that time. The author sees no reason for abandoning the principle of priority at the present stage of progress of botanical knowledge.

The arrangement of the species and larger groups follows strictly the phyletic classification. The time has come when taxonomy must readjust itself to the more modern conceptions in regard to morphology and evolution.

The map of Ohio by counties will enable one to see, at a glance, the distribution indicated, and whether a given species is considered rare or unusual in any locality. It will now be possible to concentrate attention on the exact distribution of our more interesting plants and in the near future data should be at hand to definitely delimit the natural plant regions of the state. When this can be done, a considerable advance will have been made in the knowledge of the natural agricultural and horticultural regions of Ohio.

A number of useful lists have been published in the past which are still available. Among these may be mentioned the following:

Poisonous and Other Injurious Plants of Ohio. Ohio Nat. 4: 16-19; 32-35; 69-73. 1903-1904. By the author.

Medicinal Plants of Ohio. Ohio Nat. 10: 55-60; 73-85. 1910. By Freda Detmers.

The Non-Indigenous Flora of Ohio. Univ. Bull. Series 4, No. 27. 1900. By W. A. Kellerman and Mrs. Kellerman.

To the many botanists and collectors who have aided in the preparation of this catalog during the past five years, the author wishes to express his hearty thanks. It is hoped that all who take an interest in Ohio plants will continue to send collections and rare specimens to the State Herbarium. In this way alone can a truly great collection be accumulated.

J. H. SCHAFFNER,

Department of Botany, The Ohio State University.

January 1, 1914.

WILLIAMS
FULTON
OTTAWA
SANDUSKY
ERIE
LORAIN
LAKE
ASHTABULA
GEAUGA
TRUMBULL
PORTAGE
SUMMIT
MEDINA
HURON
SENECA
WOOD
HENRY
DEFIANCE
PAULDING
PUTNAM
HANCOCK
WYANDOT
CRAWFORD
RICHLAND
ASHLAND
WAYNE
STARK
MAHONING
COLUMBIANA
VAN WERT
ALLEN
HARDIN
MERCER
AUGLAIZE
MARION
MORROW
HOLMES
TUSKARAWAS
CARROLL
JEFFERSON
HARRISON
LOGAN
SHELBY
UNION
DELAWARE
KNOX
COSHOCTON
CHAMPAIGN
MIAMI
FRANKLIN
LICKING
MUSKINGUM
GUERNSEY
BELMONT
CLARK
MADISON
PREBLE
MONTGOMERY
GREENE
FAYETTE
PICKAWAY
FAIRFIELD
PERRY
MORGAN
NOBLE
MONROE
BUTLER
WARREN
CLINTON
ROSS
HOCKING
ATHENS
WASHINGTON
VINTON
HAMILTON
CLERMONT
BROWN
HIGHLAND
PIKE
JACKSON
MEIGS
GALLIA
ADAMS
SCIOTO
LAWRENCE
OHIO

## Phylum, PTENOPHYTA

Class, FILICES. Ferns.

Subclass, EUSPORANGIATAE.

Order, *Ophioglossales.*

**Ophioglossaceae.** Adder-tongue Family.

1. Ophioglossum vulgatum L. Adder-tongue. Rather generally distributed but local.
2. Botrychium simplex Hitch. Little Grape-fern. Cedar Point, Erie County.
3. Botrychium neglectum Wood. Wood's Grape-fern. Northern counties.
4. Botrychium lanceolatum (Gmel.) Angs. Lanceleaf Grape-fern. Geauga, Portage.
5. Botrychium obliquum Muhl. Oblique Grape-fern. General.
6. Botrychium dissectum Spreng. Cutleaf Grape-fern. General.
7. Botrychium virginianum (L.) Sw. Virginia Grape-fern. General and common.

Subclass, LEPTOSPORANGIATAE.

Order, *Filicales.*

**Osmundaceae.** Royal-fern Family.

8. Osmunda regalis L. Royal-fern. General.
9. Osmunda claytoniana L. Clayton's Fern. General.
10. Osmunda cinnamomea L. Cinnamon-fern. General.

10a. Osmunda cinnamomea frondosa Gr. Wayne County.

**Polypodiaceae.** Polypody Family.

Subfamily, POLYPODIATAE.

11. Polypodium vulgare L. Common Polypody. General in the eastern half of the state.
12. Polypodium polypodioides (L.) Hitch. Gray Polypody. Adams, Hamilton.
13. Phegopteris phegopteris (L.) Und. (Dryopteris phegopteris (L.) Chr.) Long Beech-fern. Rather general but apparently local.

14. Phegopteris hexagonoptera (Mx.) Fee. (Dryopteris hexagonoptera (Mx.) Chr). Broad Beech-fern. General.
15. Phegopteris dryopteris (L.) Fee. (Dryopteris dryopteris (L.) Britt). Oak-fern. Geauga, Lake, Ashtabula, Wayne, Summit.

Subfamily, PTERIDATAE.

16. Adiantum pedatum L. Maiden-hair-fern. General and common.
16a. Adiantum pedatum laciniatum Hopkins. Wayne County.
17. Pteridium aquilinum (L.) Kuhn. Eagle-fern. General.
18. Pellaea atropurpurea (L.) Link. Purple Cliff-brake. Ottawa, Stark, Franklin, Licking, Clark, Greene, Highland, Adams.

Subfamily, ASPLENIATAE.

19. Anchistea virginica (L.) Presl. Virginia Chain-fern. Ashtabula, Defiance, Geauga, Portage, Wayne, Williams.
20. Asplenium pinnatifidum Nutt. Pinnatifid Spleenwort. Mahoning, Licking, Fairfield, Hocking, Lawrence.
21. Asplenium platyneuron (L.) Oakes. Ebony Spleenwort. General except in the northeastern fourth of the state.
21a. Asplenium platyneuron x Camptosorus rhizophyllus (Asplenium ebenoides Scott). Hocking County.
22. Asplenium resiliens Kunze. Small Spleenwort. Adams County.
23. Asplenium trichomanes L. Maidenhair Spleenwort. General except in the northwestern fourth of the state.
24. Asplenium pycnocarpon Spreng. Narrow-leaf Spleenwort. General.
25. Asplenium ruta-muraria L. Wall-rue Spleenwort. Highland, Greene.
26. Asplenium montanum Willd. Mountain Spleenwort. Hocking, Fairfield, Summit, Mahoning, (Tuscarawas—Hopkins.)
27. Athyrium thelypteroides (Mx.) Desv. Silvery Spleenwort. General.
28. Athyrium filix-foemina (L.) Roth. Lady-fern. General.
29. Camptosorus rhizophyllus (L.) Link. Walking-fern. General.

Subfamily, DRYOPTERIDATAE.

30. Dryopteris noveboracensis (L.) Gr. New York Shield-fern. General.

31. Dryopteris thelypteris (L.) Gr. Marsh Shield-fern. General.
32. Dryopteris cristata (L.) Gr. Crested Shield-fern. General.
32a. Dryopteris cristata x spinulosa. Wayne, Portage.
32b. Dryopteris cristata x intermedia. (D. boottii (Tuck.) Und.). Wayne, Geauga, Portage.
33. Dryopteris clintoniana (Eat.) Dow. Wayne, Geauga.
33a. Dryopteris clintoniana X spinulosa. Wayne County.
34. Dryopteris goldiana (Hook.) Gr. Goldie's Shield-fern. Rather general, but no specimens from the southern third of the state, nor from the northwestern counties.
35. Dryopteris intermedia (Muhl.) Gr. American Shield-fern. Rather general.
35a. Dryopteris intermedia x marginalis. Wayne County—Hopkins.
36. Dryopteris spinulosa (Muell.) Ktz. Spinulose Shield-fern. General.
37. Dryopteris dilatata (Hoffm.) Gr. Spreading Shield-fern. Tuscarawas County.
38. Dryopteris marginalis (L.) Gr. Marginal Shield-fern. General and common.
39. Polystichum acrostichoides (Mx.) Schott. Christmas-fern. General.
39a. Polystichum acrostichoides schweinitzii (Beck) Small. Wayne County.
40. Dennstaedtia punctilobula (Mx.) Moore. Boulder-fern. In the southern and eastern parts of the state. (Erie County—Moseley Herb.)
41. Filix bulbifera (L.) Und. Bulbiferous Bladder-fern. (Cystopteris.) General, but no specimens from the northwest.
42. Filix fragilis (L.) Und. Fragile Bladder-fern. General and common.
42a. Filix fragilis magnasora (Clute). Tuscarawas County.
42b. Filix fragilis cristata (Hopkins). Portage County.
43. Woodsia obtusa (Spreng.) Torr. Blunt-lobed Woodsia. In the southern half of the state.
44. Matteuccia struthiopteris (L.) Todaro. Ostrich-fern. Cuyahoga, (Erie County—Moseley Herb.).
45. Onoclea sensibilis L. Sensitive-fern. General and common.

Class, HYDROPTERIDAE. Water-ferns.

Order, *Marsileales.*

**Marsileaceae.** Marsilea Family.

46. Marsilea quadrifolia L. European Marsilea. A waif in Franklin County.

Order, *Salviniales.*

**Salviniaceae.** Salvinia Family.

47. Azolla caroliniana Willd. Carolina Azolla. Hamilton, Lucas, Lake.

Class, ISOETEAE. Quillworts.

Order, *Isoetales.*

**Isoetaceae.** Quillwort Family.

48. Isoetes braunii Durieu. Braun's Quillwort. Lake Brady, Portage County—Hopkins.
49. Isoetes foveolata Eat. Pitted Quillwort. Lake Brady, Portage County—Hopkins.

## Phylum, CALAMOPHYTA

Class, EQUISETEAE. Horsetails and Scouring-rushes.

Order, *Equisetales.*

**Equisetaceae.** Horsetail Family.

50. Equisetum hyemale L. Common Scouring-rush. General.
51. Equisetum prealtum Raf. Great Scouring-rush. (E. robustum A. Br.). General in the state.
52. Equisetum variegatum Schleich. Variegated Scouring-rush. Lake, Erie.
53. Equisetum laevigatum A. Br. Smooth Scouring-rush. General but apparently not common.
54. Equisetum fluviatile L. Swamp Horsetail. Not common but to be found in most parts of the state in suitable places.
55. Equisetum sylvaticum L. Wood Horsetail. Auglaize, Cuyahoga, Geauga.
56. Equisetum pratense Ehrh. Thicket Horsetail. Supposed to occur in the state but no definite specimens.
57. Equisetum arvense L. Field Horsetail. General and abundant.

## Phylum, LEPIDOPHYTA

Class, LYCOPODIEAE. Lycopods.

Order, *Lycopodiales.*

**Lycopodiaceae.** Club-moss Family.

58. Lycopodium lucidulum Mx. Shining Club-moss. General in the eastern half of the state.

59. Lycopodium porophilum Lloyd & Und. Rock Club-moss. Licking, Fairfield, Hocking, Portage.

60. Lycopodium inundatum L. Bog Club-moss. Portage County.

61. Lycopodium clavatum L. Common Club-moss. Ashtabula, Cuyahoga, Geauga, Portage, Hocking, (Stark—Hopkins).

62. Lycopodium obscurum L. Tree Club-moss. Ashtabula, Lake, Medina, Portage, Licking, Defiance, Fairfield, Hocking.

63. Lycopodium complanatum L. Trailing Club-moss. Ashtabula, Cuyahoga, Carroll, Geauga, Licking, Fairfield, Hocking, Portage, Lake, (Erie—Moseley), (Wayne—Hopkins).

Class, SELAGINELLEAE. Selaginellas.

Order, *Selaginellales.*

**Selaginellaceae.** Selaginella Family.

64. Selaginella rupestris (L.) Spring. Rock Selaginella. Licking, Fairfield, Hocking.

65. Selaginella apus (L.) Spring. Creeping Selaginella. Lake, Trumbull.

## Phylum, STROBILOPHYTA

Class, CONIFERAE. Conifers.

Order, *Pinales.*

**Pinaceae.** Pine Family.

66. Tsuga canadensis (L.) Carr. Hemlock. Eastern half of Ohio: occasional toward the west.

67. Larix laricina (DuR.) Koch. Tamarack. Northern third of the state.

68. Pinus strobus L. White Pine. Northern part of Ohio.

69. Pinus rigida Mill. Pitch Pine. Lawrence, Scioto, Jackson, Fairfield.

70. Pinus virginiana Mill. Scrub Pine. From Licking County southward.

71. Pinus echinata Mill. Yellow Pine. Auglaize County. Probably accidental from seed from cultivated trees. Not native.

**Juniperaceae.** Juniper Family.

Subfamily, CUPRESSATAE.

72. Thuja occidentalis L. Arborvitae. Champaign, Franklin, Greene, Highland, Adams.

Subfamily, JUNIPERATAE.

73. Juniperus communis L. Common Juniper. Northern Ohio, as far south as Fairfield County.

74. Juniperus sibirica Burgs. Low Juniper. Erie County.

75. Juniperus virginiana L. Red Juniper. General.

Order, *Taxales.*

**Taxaceae.** Yew Family.

76. Taxus canadensis Marsh. American Yew. Northern Ohio, as far south as Hocking, Highland, and Greene Counties.

## Phylum, ANTHOPHYTA

Class, MONOCOTYLAE. Monocotyls.

Subclass, HELOBIAE.

Order, *Alismales.*

**Alismaceae.** Water-plantain Family.

77. Lophotocarpus calycinus (Eng.) Sm. Large Lophotocarpus. Erie, Ottawa, Auglaize.

78. Sagittaria latifolia Willd. Broadleaf Arrow-head. General and abundant.

79. Sagittaria cuneata Sheld. Arum-leaf Arrow-head. (Erie County—Moseley Herbarium.)

80. Sagittaria rigida Pursh. Sessile-fruited Arrow-head. Mostly in the northern counties.

81. Sagittaria graminea Mx. Grassleaf Arrow-head. Lucas County.

82. Alisma subcordatum Raf. American Water-plantain. General.

**Scheuchzeriaceae.** Arrow-grass Family.

83. Triglochin palustris L. Marsh Arrow-grass. Erie, Madison.
84. Triglochin maritima L. Seaside Arrow-grass. Summit, Stark, Clark, Champaign.
85. Scheuchzeria palustris L. Scheuchzeria. Licking, Ashtabula.

**Potamogetonaceae.** Pondweed Family.

86. Potamogeton natans L. Common Floating Pondweed. General.
87. Potamogeton amplifolius Tuck. Large-leaf Pondweed. Wayne, Stark, Summit, Erie.
88. Potamogeton epihydrus Raf. Nuttall's Pondweed. Trumbull, Wayne.
89. Potamogeton americanus Cham. & Schl. Longleaf Pondweed. Rather general.
90. Potamogeton heterophyllus Schreb. Variant-leaf Pondweed. Ottawa, Erie, Wayne, Stark, Ashtabula.
91. Potamogeton angustifolius Berch & Presl. Narrowleaf Pondweed. Wayne County.
92. Potamogeton lucens L. Shining Pondweed. Summit, Cuyahoga, Wayne, Erie.
93. Potamogeton praelongus Wulf. White-stem Pondweed. Ashtabula, Wayne.
94. Potamogeton perfoliatus L. Clasping-leaf Pondweed. Erie, Summit.
95. Potamogeton compressus L. Eel-grass Pondweed. Perry, Logan, Erie, Stark.
96. Potamogeton hillii Mor. Hill's Pondweed. (Ottawa County—Moseley Herbarium.)
97. Potamogeton foliosus Raf. Leafy Pondweed. General.
98. Potamogeton obtusifolius Mert. & Koch. Bluntleaf Pondweed. Medina County.
99. Potamogeton friesii Rupr. Fries' Pondweed. (Erie County—Moseley Herbarium.)
100. Potamogeton pusillus L. Small Pondweed. Erie, Auglaize, Fairfield, Perry, Summit.
101. Potamogeton diversifolius Raf. Rafinesque's Pondweed. Ashtabula, Portage.

102. Potamogeton pectinatus L. Fennel-leaf Pondweed. General.

103. Potamogeton interruptus Kit. Interrupted Pondweed. Erie County.

104. Potamogeton robbinsii Oakes. Robbins' Pondweed. Erie, Summit.

105. Zannichellia palustris L. Zannachellia. General.

**Naiadaceae.** Naias Family.

106. Naias flexilis (Willd.) Rost. & Schm. Slender Naias. General.

107. Naias gracillima (A. Br.) Magnus. Thread-like Naias. Wayne County.

Order, *Nymphaeales.*

**Nymphaeaceae.** Water-lily Family.

Subfamily, CABOMBATAE.

108. Brasenia schreberi Gmel. Water-shield. Geauga, Summit, Portage, Stark, Wayne.

Subfamily, NELUMBONATAE.

109. Nelumbo lutea (Willd.) Pers. American Water-lotus. Licking, Perry, Erie, Auglaize.

Subfamily, NYMPHAEATAE.

110. Nymphaea advena Sol. Large yellow Water-lily. General.

111. Castalia odorata (Dry.) W. & W. Sweet-scented White Water-lily. Rather general.

112. Castalia tuberosa (Paine) Greene. Tuberous White Water-lily. Erie, Holmes, Licking.

Order, *Hydrocharitales.*

**Vallisneriaceae.** Tape-grass Family.

113. Philotria canadensis (Mx.) Britt. Common Water-weed. General.

114. Philotria minor (Eng.) Small. Lesser Water-weed. No specimens.

115. Vallisneria spiralis L. Tape-grass. Shelby, Fairfield, Stark, Summit, Geauga, Erie.

Subclass, SPADICIFLORAE.

Order, *Pandanales.*

**Sparganiaceae.** Bur-reed Family.

116. Sparganium eurycarpum Eng. Broad-fruited Bur-reed. General.
117. Sparganium androcladum (Eng.) Morong. Branching Bur-reed. Franklin, Auglaize, Lucas.
118. Sparganium lucidum Fern. & Eames. Shining-fruited Bur-reed. Richland County.
119. Sparganium simplex Huds. Simple-stemmed Bur-reed. (Erie County—Moseley Herbarium.)

**Typhaceae.** Cat-tail Family.

120. Typha latifolia L. Broad-leaf Cat-tail. General.
121. Typha angustifolia L. Narrow-leaf Cat-tail. Auglaize, Licking, Knox, Erie, Cuyahoga, Geauga.

Order, *Arales.*

**Araceae.** Arum Family.

Subfamily, POTHATAE.

122. Acorus calamus L. Sweet-flag. General.

Subfamily, CALLATAE.

123. Calla palustris L. Wild Calla. Ashtabula, Portage, Summit, Stark.
124. Spathyema foetida (L.) Raf. Skunk-cabbage. General.

Subfamily, PHILODENDRATAE.

125. Peltrandra virginica (L.) Kunth. Green Arrow-arum. Cuyahoga, Summit, Stark, Licking, Perry.

Subfamily, ARATAE.

126. Arisaema triphyllum (L.) Torr. Jack-in-the-pulpit. General.
127. Arisaema dracontium (L.) Schott. Green-dragon. General.

**Lemnaceae.** Duckweed Family.

128. Spirodela polyrhiza (L.) Schl. Greater Duckweed. General.

129. Lemna trisulca L. Ivy-jointed Duckweed. General.
130. Lemna cyclostasa (Ell.) Chev. Valdivia Duckweed. Lake County.
131. Lemna minor L. Lesser Duckweed. General.
132. Wolffiella floridiana (J. D. Sm.) Thomp. Florida Wolffiella. Licking County.
133. Wolffia columbiana Karst. Columbia Wolffia. Ottawa, Franklin.
134. Wolffia punctata Griseb. Punctate Wolffia. Erie County.

Subclass, GLUMIFLORAE.

Order, *Graminales.*

**Cyperaceae.** Sedge Family.

Subfamily, SCIRPATAE.

135. Cyperus schweinitzii Torr. Schweinitz's Cyperus. Erie, Cuyahoga.
136. Cyperus esculentus L. Nut-grass (Cyperus). Western half of state, as far east as Wayne County.
137. Cyperus erythrorhizos Muhl. Red-rooted Cyperus. Rather general.
138. Cyperus inflexus Muhl. Awned Cyperus. Lucas, Champaign.
139. Cyperus strigosus L. Straw-colored Cyperus. General.
140. Cyperus filiculmis Vahl. Slender Cyperus. Rather general.
141. Cyperus engelmanni Steud. Engelmann's Cyperus. Wayne, Logan.
142. Cyperus speciosus Vahl. Michaux's Cyperus. Ashtabula, Erie.
143. Cyperus flavescens L. Yellow Cyperus. Fairfield, Richland, Meigs.
144. Cyperus diandrus Torr. Low Cyperus. Northern half of state, as far south as Champaign County.
145. Cyperus rivularis Kunth. Shining Cyperus. Rather general.
146. Kyllinga pumila Mx. Low Kyllinga. Fairfield, Hocking, Cuyahoga, Auglaize.
147. Dulichium arundinaceum (L.) Britt. Dulichium. Northern part of the state, south to Hocking and Clark Counties.
148. Eleocharis mutata (L.) R. & S. Four-angled Spike-rush. Ashland County.

149. Eleocharis olivacea Torr. Olivaceous Spike-rush. Auglaize, Licking, Summit, Cuyahoga.
150. Eleocharis ovata (Roth) R. & S. Ovoid Spike-rush. Erie County.
151. Eleocharis obtusa (Willd.) Schul. Blunt Spike-rush. General.
152. Eleocharis engelmanni Steud. Engelmann's Spike-rush. Licking County.
153. Eleocharis palustris (L.) R. & S. Creeping Spike-rush. General.
154. Eleocharis acicularis (L.) R. & S. Needle Spike-rush. General.
155. Eleocharis tenuis (Willd.) Schultes. Slender Spike-rush. Lucas, Ottawa.
156. Eleocharis acuminata (Muhl.) Nees. Flat-stemmed Spike-rush. Lucas, Ottawa, Auglaize.
157. Eleocharis intermedia (Muhl.) Schultes. Matted Spike-rush. Erie, Franklin.
158. Stenophyllus capillaris (L.) Britt. Hair-like Stenophyllus. Lucas County.
159. Fimbristylis autumnalis (L.) R. & S. Slender Fimbristylis. Hamilton, Defiance, Fairfield, Hocking.
160. Scirpus cyperinus (L.) Kunth. Wool-grass. General.
161. Scirpus lineatus Mx. Reddish Bulrush. General.
162. Scirpus polyphyllus Vahl. Leafy Bulrush. Eastern half of the state to Crawford and Adams Counties.
163. Scirpus atrovirens Muhl. Dark-green Bulrush. General.
164. Scirpus sylvaticus L. Wood Bulrush. Ottawa, Wayne, Hamilton.
165. Scirpus fluviatilis (Torr.) Gr. River Bulrush. Champaign, Licking, Lucas, Wayne, Medina, Lake.
166. Scirpus validus Vahl. Great Bulrush. General.
167. Scirpus torreyi Olney. Torrey's Club-rush. Lake, Erie.
168. Scirpus americanus Pers. Chair-maker's Club-rush. General.
169. Scirpus debilis Pursh. Weak Club-rush. Summit, Ottawa.
170. Scirpus planifolius Muhl. Flat-leaf Club-rush. Licking, Knox, Lake.
171 Eriophorum viridicarinatum (Eng.) Fern. Thin-leaf Cotton-grass. Geauga, Summit, Licking.
172. Eriophorum virginicum L. Virginia Cotton-grass. Northern Ohio, as far south as Licking County.

Subfamily, RYNCHOSPORATAE.

173. Rynchospora corniculata (Lam.) Gr. Horned-rush. None in the herbarium.
174. Rynchospora alba (L.) Vahl. White Beaked-rush. Geauga, Lorain, Summit, Ashland, Stark, Licking, Champaign.
175. Rynchospora capillacea Torr. Capillary Beaked-rush. Madison, Greene, Champaign, Erie.
176. Rynchospora glomerata (L.) Vahl. Clustered Beak-rush. Erie, Ashtabula, Portage, Summit, Fairfield.
177. Rynchospora cymosa Ell. Grass-like Beak-rush. Erie County.
178. Mariscus mariscoides (Muhl.) Kuntze. Twig-rush. Erie County.
179. Scleria triglomerata Mx. Tall Nut-rush. Erie County.
180. Scleria pauciflora Muhl. Papillose Nut-rush. Erie County.
181. Scleria verticillata Muhl. Low Nut-rush. Erie, Franklin, Champaign.

Subfamily, CARICATAE.

182. Carex sartwellii Dew. Sartwell's Sedge. Erie County.
183. Carex siccata Dew. Dry-spiked Sedge. No specimens. (Erie County—Moseley Herbarium.)
184. Carex retroflexa Muhl. Reflexed Sedge. From Erie, Huron, Wayne, Knox and Perry Counties westward.
185. Carex rosea Schk. Stellate Sedge. General.
186. Carex muricata L. Lesser Prickly Sedge. No specimens. (Erie County—Moseley Herbarium.) Naturalized from Europe.
187. Carex muhlenbergii Schk. Muhlenberg's Sedge. Carroll, Summit, Cuyahoga, Erie, Lucas.
188. Carex cephalophora Muhl. Oval-headed Sedge. General.
189. Carex gravida Bail. Heavy Sedge. No specimens.
190. Carex cephaloidea Dew. Thinleaf Sedge. Cuyahoga, Licking.
191. Carex sparganioides Muhl. Bur-reed Sedge. General.
192. Carex conjuncta Boott. Soft Fox Sedge. General, but no specimens from the eastern and southern counties.
193. Carex vulpinoidea Mx. Fox Sedge. General and abundant.
194. Carex setacea Dew. Bristly-spiked Sedge. Erie County.
195. Carex diandra Schr. Lesser Panicled Sedge. Lake County.
196. Carex prairea Dew. Prairie Sedge. Summit, Erie.
197. Carex decomposita Muhl. Large-panicled Sedge. Licking County.

198. Carex stipitata Muhl. Awl-fruited Sedge. General, but no specimens from the extreme southern and southeastern counties.
199. Carex crus-corvi Shuttlw. Raven-foot Sedge. Defiance, Auglaize, Wayne.
200. Carex disperma Dew. Soft-leaf Sedge. Erie County.
201. Carex trisperma Dew. Three-fruited Sedge. Lake, Portage, Summit, Williams.
202. Carex canescens L. Silvery Sedge. Summit, Lorain, Logan.
203. Carex brunnescens (Pers.) Poir. Brownish Sedge. Logan County.
204. Carex deweyana Schw. Dewey's Sedge. Auglaize County.
205. Carex bromoides Schk. Brome-like Sedge. Cuyahoga, Erie, Hancock, Hardin, Auglaize.
206. Carex interior Bail. Inland Sedge. Cuyahoga, Summit, Erie, Stark, Licking.
207. Carex leersii Willd. Little Prickly Sedge. Ottawa, Erie, Madison, Geauga, Portage.
208. Carex scoparia Schk. Pointed Broom Sedge. Northern Ohio, as far south as Auglaize, Madison and Tuscarawas Counties.
209. Carex tribuloides Wahl. Blunt Broom Sedge. General.
210. Carex cristatella Britt. Crested Sedge. General.
211. Carex muskingumensis Schw. Muskingum Sedge. Defiance, Auglaize, Wyandot, Franklin, Champaign.
212. Carex bebbii Olney. Bebb's Sedge. Franklin County.
213. Carex straminea Willd. Straw Sedge. Cuyahoga, Portage, Lucas, Williams.
214. Carex normalis Mack. Larger Straw Sedge. Hamilton, Auglaize, Wayne, Hancock, (Erie County—Moseley Herbarium).
215. Carex festucacea Schk. Fescue Sedge. Lake, Erie, Stark, Logan, Madison.
216. Carex bicknellii Britt. Bicknell's Sedge. Lake County, (Erie County—Moseley Herbarium).
217. Carex alata Torr. Broad-winged Sedge. Summit County.
218. Carex albolutescens Schw. Greenish-white Sedge. Champaign County.
219. Carex foenea Willd. Hay Sedge. Geauga County.
220. Carex willdenovii Schk. Willdenow's Sedge. Cuyahoga County.
221. Carex jamesii Schw. James' Sedge. General.
222. Carex durifolia Bail. Back's Sedge. No specimens.

223. Carex leptalea Wahl. Bristle-stalked Sedge. Lake, Cuyahoga, Summit, Madison.

224. Carex communis Bail. Fibrous-rooted Sedge. Summit County. (Erie County—Moseley Herbarium).

225. Carex pennsylvanica Lam. Pennsylvania Sedge. General.

226. Carex varia Muhl. Emmons' Sedge. From Erie, Madison, and Clermont Counties eastward.

227. Carex hirtifolia Mack. Pubescent Sedge. From Lake, Wayne, Delaware, and Greene Counties northwestward.

228. Carex pedunculata Muhl. Long-stalked Sedge. Lake, Cuyahoga, Geauga, Erie.

229. Carex richardsonii R. Br. Richardson's Sedge. (Erie County —Moseley Herbarium.)

230. Carex eburnea Boott. Bristle-leaf Sedge. Greene, Ottawa.

231. Carex aurea Nutt. Golden-fruited Sedge. Erie County.

232. Carex meadii Dew. Mead's Sedge. Erie County.

233. Carex tetanica Schk. Wood's Sedge. Geauga, Cuyahoga, Erie, Huron, Auglaize.

234. Carex plantaginea Lam. Plantain-leaf Sedge. Fairfield, Delaware, Huron, Lorain, Cuyahoga, Summit.

235. Carex careyana Torr. Carey's Sedge. Lorain County.

236. Carex platyphylla Car. Broadleaf Sedge. From Cuyahoga, Knox, Fairfield, and Hocking Counties eastward.

237. Carex digitalis Willd. Slender Wood Sedge. Rather general.

238. Carex laxiculmis Schw. Spreading Sedge. Lake, Cuyahoga, Auglaize, Franklin.

239. Carex albursina Sheld. White Bear Sedge. General.

240. Carex blanda Dew. Woodland Sedge. Rather general.

241. Calex laxiflora Lam. Loose-flowered Sedge. Rather general.

242. Carex anceps Muhl. Two-edged Sedge. Rather general.

243. Carex shriveri Britt. Shriver's Sedge. No specimens.

244. Carex granularis Muhl. Meadow Sedge. General, but no specimens from the southeastern counties.

245. Carex crawei Dew. Crawe's Sedge. Erie County.

246. Carex oligocarpa Schk. Few-fruited Sedge. Hamilton, Montgomery, Greene, Ross.

247. Carex hitchcockiana Dew. Hitchcock's Sedge. Butler, Highland, Auglaize.

248. Carex conoidea Schk. Field Sedge. Wood County.
249. Carex amphibola Steud. Narrow-leaf Sedge. Cuyahoga, Hardin, Auglaize.
250. Carex grisea Wahl. Gray Sedge. Rather general, but the only southern county represented is Lawrence.
251. Carex glaucodea Tuck. Glaucescent Sedge. Cuyahoga County.
252. Carex gracillima Schw. Graceful Sedge. Northern Ohio, as far south as Licking and Franklin Counties.
253. Carex prasina Wahl. Drooping Sedge. Trumbull, Cuyahoga, Crawford, Fairfield, Hamilton.
254. Carex davisii Schw. Davis' Sedge. Lake, Lorain, Wayne, Auglaize, Licking, Ross.
255. Carex flexuosa Muhl. Slender-stalked Sedge. Cuyahoga, Geauga, Lake.
256. Carex arctata Boott. Drooping Wood Sedge. Summit County, (Erie County—Moseley Herbarium).
257. Carex virescens Muhl. Ribbed Sedge. Northern Ohio, as far south as Geauga, Hocking, and Auglaize Counties.
258. Carex complanata Torr. Hirsute Sedge. General.
259. Carex scabrata Schw. Rough Sedge. Lake, Cuyahoga, Summit.
260. Carex limosa L. Mud Sedge. No specimens.
261. Carex paupercula Mx. Bog Sedge. Licking County.
262. Carex buxbaumii Wahl. Brown Sedge. Lorain, Erie, Lucas.
263. Carex shortiana Dew. Short's Sedge. General; no specimens from the southeastern counties.
264. Carex stricta Lam. Tussock Sedge. From Trumbull, Madison, Champaign, and Auglaize Counties, northward.
265. Carex haydeni Dew. Hayden's Sedge. No specimens; (Moseley Herbarium—Erie County).
266. Carex torta Boott. Twisted Sedge. Cuyahoga, Erie, Hardin, Knox, Delaware, Franklin.
267. Carex aquatilis Wahl. Water Sedge. Auglaize, Lucas.
268. Carex gynandra Schw. Nodding Sedge. Harrison, Perry.
269. Carex crinita Lam. Fringed Sedge. General.
270. Carex lacustris Willd. Lake-bank Sedge. Northern Ohio, south to Summit, Morrow, and Logan Counties.
271. Carex impressa (Wright) Mack. Wright's Sedge. No specimens.
272. Carex lanuginosa Mx. Woolly Sedge. From Ashtabula, Franklin, Madison, Champaign, and Auglaize Counties northward.

273. Carex lasiocarpa Ehrh. Slender Sedge. Licking, Stark.
274. Carex trichocarpa Muhl. Hairy-fruited Sedge. Lorain, Erie, Licking, Madison.
275. Carex atherodes Spreng. Awned Sedge. Erie County.
276. Carex oederi Retz. Green Sedge. Erie County.
277. Carex flava L. Yellow Sedge. Lake County.
278. Carex folliculata L. Long Sedge. Crawford, Portage.
279. Carex monile Tuck. Necklace Sedge. Lake, Cuyahoga, Wayne, Lucas.
280. Carex vesicaria L. Inflated Sedge. No specimens.
281. Carex rostrata Stokes. Beaked Sedge. Licking, Geauga.
282. Carex tuckermanii Dew. Tuckerman's Sedge. Northern Ohio, south to Auglaize, Franklin, and Perry Counties.
283. Carex retrorsa Schw. Retrorse Sedge. Lucas County.
284. Carex oligosperma Mx. Few-seeded Sedge. Defiance County.
285. Carex lurida Wahl. Sallow Sedge. General; no specimens from the northwestern counties.
286. Carex hystricina Muhl. Porcupine Sedge. Rather general.
287. Carex pseudo-cyperus L. Cyperus-like Sedge. Greene, Tuscarawas, Wayne.
288. Carex comosa Boott. Bristly Sedge. Northern part of the state, as far south as Champaign, Franklin, and Tuscarawas Counties.
289. Carex frankii Kunth. Frank's Sedge. General as far north as Auglaize, Knox, and Jefferson Counties; also in Wyandot, Erie, and Cuyahoga.
290. Carex squarrosa L. Squarrose Sedge. General.
291. Carex typhina Mx. Cat-tail Sedge. Lake, Cuyahoga, Morrow, Scioto.
292. Carex intumescens Rudge. Bladder Sedge. Northern Ohio, as far south as Trumbull, Crawford, and Allen Counties.
293. Carex asa-grayi Bail. Gray's Sedge. General.
294. Carex lupulina Muhl. Hop Sedge. Rather general.
295. Carex lupuliformis Sartw. Hop-like Sedge. Cuyahoga, Wayne, Marion.

**Graminaceae.** Grass Family.

Subfamily, POACATAE.

296. Bromus brizaeformis Fisch. & Mey Awnless Chess. Introduced. Cuyahoga County.

297. Bromus kalmii Gr. Kalm's Chess. Franklin, Lucas.
298. Bromus hordeaceus L. Soft Chess. Introduced. Wayne, Lorain.
299. Bromus secalinus L. Common Chess. Naturalized. General and abundant.
300. Bromus racemosus L. Upright Chess. Naturalized. General and abundant.
301. Bromus arvensis L. Field Chess. Introduced. Franklin County.
302. Bromus inermis Leyss. Hungarian Brome-grass. Introduced. Wayne County.
303. Bromus ciliatus L. Fringed Brome-grass. Erie, Wayne, Franklin, Champaign, Hocking.
304. Bromus purgans L. Hairy Brome-grass. General.
305. Bromus asper Murr. Rough Brome-grass. No specimens. European.
306. Bromus tectorum L. Downy Brome-grass. Introduced. General and abundant.
307. Bromus sterilis L. Barren Brome-grass. Introduced. Licking, Sandusky, Cuyahoga.
308. Melica nitens Nutt. Tall Melic-grass. Erie County.
309. Festuca elatior L. Tall Fescue-grass. Introduced. General.
310. Festuca nutans Willd. Nodding Fescue-grass. General.
311. Festuca ovina L. Sheep Fescue-grass. From Europe. Erie, Franklin, Wayne.
312. Festuca capillata Lam. Filiform Fescue-grass. From Europe. Cuyahoga County.
313. Festuca octoflora Walt. Slender Fescue-grass. Ashtabula, Erie, Lucas, Ashland, Delaware, Licking, Lawrence.
314. Festuca myuros L. Rat-tail Fescue-gress. From Europe. Lake County.
315. Panicularia acutiflora (Torr) Ktz. Sharp-glumed Manna-grass. No specimens.
316. Panicularia fluitans (L.) Ktz. Floating Manna-grass. General as far south as Harrison, Perry, Franklin, and Auglaize Counties.
317. Panicularia canadensis (Mx.) Ktz. Rattlesnake Manna-grass. Ashtabula, Geauga, Portage, Cuyahoga, Lorain, Summit, Stark, Wayne.

318. Panicularia torreyana (Spreng.) Merr. Long Manna-grass. Ashtabula, Cuyahoga, Summit, Erie, Fairfield.

319. Panicularia nervata (Willd.) Ktz. Nerved Manna-grass. General.

320. Panicularia grandis (Wats.) Nash. Tall Manna-grass. Stark, Wayne.

321. Panicularia pallida (Torr.) Ktz. Pale Manna-grass. (Ottawa County—Moseley Herbarium.)

322. Poa compressa L. Flat-stemmed Blue-grass. From Europe. General and abundant.

323. Poa trivialis L. Rough-stalked Meadow-grass. From Europe. Crawford County.

324. Poa debilis Torr. Weak Spear-grass. (Erie County—Moseley Herbarium.)

325. Poa triflora Gilib. Fowl Meadow-grass. Fairfield, Geauga, Lawrence.

326. Poa nemoralis L. Wood Meadow-grass. Introduced. Lake County.

327. Poa pratensis L. Kentucky Blue-grass. General and abundant.

328. Poa autumnalis Muhl. Flexuous Spear-grass. Hocking County.

329. Poa sylvestris Gr. Sylvan Spear-grass. Rather general; no specimens from the northwestern counties.

330. Poa alsodes Gr. Grove Meadow-grass. Seneca, Franklin, Summit, Cuyahoga, Trumbull, Knox.

331. Poa brachyphylla Schult. Short-leaf Spear-grass. Lawrence, Perry, Medina, Cuyahoga, Trumbull.

332. Poa annua L. Annual Meadow-grass. From Europe. General.

333. Dactylis glomerata L. Orchard-grass. Naturalized. General; no specimens from the southeastern counties.

334. Eragrostis pectinacea (Mx.) Steud. Purple Love-grass. Lake, Cuyahoga, Erie, Auglaize.

335. Eragrostis hypnoides (Lam.) B. S. P. Creeping Love-grass. Rather general; no specimens from the central eastern counties.

336. Eragrostis major Host. Strong-scented Love-grass. Naturalized. General.

337. Eragrostis purshii Schrad. Pursh's Love-grass. Erie County.

338. Eragrostis pilosa (L.) Beauv. Tufted Love-grass. Rather general; no specimens from the northwestern counties. Naturalized.
339. Eragrostis frankii Steud. Frank's Love-grass. Rather general; no specimens from the southeastern nor from the northwestern counties.
340. Eragrostis capillaris (L.) Nees. Capillary Love-grass. Ottawa, Madison, Clinton.
341. Sphenopholis obtusata (Mx.) Scribn. Blunt-scaled Eaton-grass. No specimens.
342. Sphenopholis pallens (Spreng.) Scribn. Tall Eaton-grass. General.
343. Sphenopholis nitida (Spreng.) Scribn. Slender Eaton-grass. Cuyahoga, Knox, Licking, Fairfield, Hocking, Lawrence, Adams.
344 Koeleria cristata (L.) Pers. Crested Koeler-grass. Ottawa County.
345. Korycarpus arundinaceus Zea. American Korycarpus. Ross, Franklin, Auglaize, Highland.
346. Tridens flava (L.) Hitch. Tall Purple-top. Rather general; no specimens from the northwestern counties nor the extreme eastern part.
347. Triplasis purpurea (Walt.) Chapm. Purple Sand-grass. Ashtabula, Cuyahoga, Erie.
348. Cynosurus cristatus L. Dogtail-grass. From Europe. Mahoning County.
349. Phragmites phragmites (L.) Karst. Common Reed-grass. Ashtaubula, Cuyahog, Erie, Lucas, Huron, Wayne, Franklin.
350. Danthonia spicata (L.) Beauv. Common Wild-oat-grass. General.
351. Danthonia compressa Aust. Flattened Wild-oat-grass. Portage County.
352. Arrenatherum elatius (L.) Beauv. Oat-grass. From Europe. Hamilton County.
353. Trisetum pennsylvanicum (L.) Beauv. Marsh False-oats. No specimens.
354. Avena torreyi Nash. Purple Oats. Franklin County.
355. Avena sativa L. Common Oats. Rather general. Escaped from cultivation.

356. Avena fatua L. Wild Oats. From Europe. No specimens.
357. Deschampsia flexuosa (L.) Trin. Wavy Hair-grass. Portage County.
358. Aspris caryophyllea (L.) Nash. Silvery Hair-grass. From Europe. Lake County.
359. Notholcus lanatus (L.) Nash. Velvet-grass. Lake, Trumbull, Cuyahoga, Lorain, Erie, Wayne, Fairfield. From Europe.
360. Lolium perenne L. Red Darnel. Rather general. From Europe.
361. Lolium multiflorum Lam. Awned Darnel. Hamilton, Madison. From Europe.
362. Lolium temulentum L. Poison Darnel. No specimens. From Europe.
363. Agropyron repens (L.) Beauv. Couch-grass. Rather general; no specimens from the southeastern part of the state. From Europe.
364. Agropyron caninum (L.) R. & S. Awned Wheat-grass. Portage County. From Europe.
365. Triticum vulgare L. Wheat. Erie, Belmont, Harrison, Tuscarawas, Morrow, Fayette, Madison, Preble, Franklin. Escaped from cultivation.
366. Secale cereale L. Rye. Erie, Morrow, Franklin, Scioto. Escaped.
367. Elymus virginicus L. Virginia Wild-rye. General.
368. Elymus hirsutiglumis Scrib. & Sm. Strict Wild-rye. Ottawa, Huron.
369. Elymus canadensis L. Nodding Wild-rye. Rather general.
370. Elymus striatus Willd. Slender Wild-rye. Wayne, Erie, Auglaize.
371. Hystrix hystrix (L.) Millsp. Bottle-brush-grass. General.
372. Hordeum vulgare L. Common Barley. Franklin, Tuscarawas, Portage. Escaped from cultivation.
373. Hordeum distichum L. Two-rowed Barley. Escaped in Lake County.
374. Hordeum nodosum L. Meadow Barley. Hamilton County.
375. Hordeum jubatum L. Squirrel-tail Barley. From Lake to Lucas County; also in Franklin, Madison, Greene, Allen, Defiance, and Williams. Naturalized from the West.

376. Spartina michauxiana Hitch. Tall Slough-grass. Rather general; no specimens from the central eastern nor from the southwestern counties.
377. Beckmannia erucaeformis (L.) Host. Beckmannia. Cuyahoga County.
378. Capriola dactylon (L.) Ktz. Bermuda-grass. No specimens. From Europe.
379. Eleusine indica (L.) Gaert. Yard-grass. General. Naturalized.
380. Atheropogon curtipendulus (Mx.) Fourn. Tall Gramma-grass. Lake, Erie, Ottawa, Franklin, Adams.
381. Bouteloua hirsuta Lag. Hairy Mesquite-grass. Waifs in Franklin County.
382. Bouteloua oligostachya (Nutt.) Torr. Smooth Mesquite-grass. Waifs in Franklin County.
383. Sporobolus asper (Mx.) Kunth. Longleaf Rush-grass. Lake, Erie, Franklin.
384. Sporobolus vaginaeflorus (Torr.) Wood. Sheathed Rush-grass. Auglaize, Madison, Warren, Vinton, Athens.
385. Sporobolus neglectus Nash. Small Rush-grass. Cuyahoga, Wayne, Huron, Auglaize.
386. Sporobolus cryptandrus (Torr.) Gr. Sand Dropseed. Lucas, Ottawa, Erie, Lorain.
387. Sporobolus heterolepis Gr. Northern Dropseed. Franklin, Madison, Champaign.
388. Calamagrostis canadensis (Mx.) Beauv. Bluejoint Reed-grass. Northern Ohio, as far south as Stark, Franklin, and Auglaize Counties.
389. Calamagrostis cinnoides (Muhl.) Scrib. Nuttall's Reed-grass. No specimens.
390. Agrostis alba L. Red-top. General. From Europe.
391. Agrostis schweinitzii Trin. Thin Bent-grass. Rather general.
392. Agrostis hyemalis (Walt.) B. S. P. Rough Silk-grass. Rather general, but no specimens from the northwestern nor southeastern counties.
393. Apera spica-venti (L.) Beauv. Silky Windlestraw. From Europe. Lake County.
394. Cinna arundinacea L. Wood Reed-grass. General.
395. Ammophila arenaria (L.) Link. Sand Beech-grass. Erie County.

396. Alopecurus geniculatus L. Marsh Foxtail. Lake, Ottawa, Crawford, Auglaize, Madison, Franklin, Perry. Introduced.

397. Alopecurus pratensis L. Meadow Foxtail. No specimens. From Europe.

398. Heleochloa schoenoides (L.) Host. Cat-tail-grass. Greene County. From Europe.

399. Phleum pratense L. Timothy. General. From Europe.

400. Muhlenbergia sobolifera (Muhl.) Trin. Rock Muhlenbergia. Highland, Wayne.

401. Muhlenbergia mexicana (L.) Trin. Mexican Muhlenbergia. General.

402. Muhlenbergia racemosa (Mx.) B. S. P. Marsh Muhlenbergia. Summit, Wayne, Huron, Wyandot, Champaign, Licking.

403. Muhlenbergia umbrosa Scribn. Wood Muhlenbergia. Cuyahoga, Champaign.

404. Muhlenbergia tenuiflora (Willd.) B. S. P. Slender Muhlenbergia. Portage, Wayne, Fairfield, Madison, Greene.

405. Muhlenbergia schreberi Gmel. Spreading Muhlenbergia. General.

406. Brachyelytrum erectum (Schreb.) Beauv. Brachyelytrum. Cuyahoga, Portage, Lorain, Wayne, Highland, Franklin, Madison, Hocking, Adams.

407. Milium effusum L. Tall Millet-grass. Lake, Cuyahoga, Lorain, Wayne, Stark.

408. Oryzopsis racemosa (Sm.) Ricker. Black-fruited Mountain-rice. Geauga, Summit, Erie, Greene, Highland.

409. Stipa spartea Trin. Porcupine-grass. Erie County, where it occurs on Cedar Point.

410. Aristida dichotoma Mx. Poverty-grass. Scioto, Vinton, Fairfield.

411. Aristida oligantha Mx. Few-flowered Triple-awned-grass. Cuyahoga County.

412. Aristida gracilis Ell. Slender Triple-awned-grass. Hamilton, Clermont, Athens, Erie, Cuyahoga.

413. Aristida purpurascens Poir. Purplish Triple-awned-grass. Wood, Fulton.

414. Savastana odorata (L.) Scrib. Vanilla-grass. Trumbull, Madison, Pickaway.

415. Phalaris arundinacea L. Reed Canary-grass. Rather general; no specimens from the northwestern nor from the southeastern counties.
416. Phalaris canariensis L. Canary-grass. Montgomery, Hamilton. From Europe.
417. Anthoxanthum odoratum L. Sweet Vernal-grass. Ashtabula, Cuyahoga, Summit, Mahoning, Wayne, Franklin. From Europe.
418. Anthoxanthum puelii Lec. & Lamotte. Long-awned Vernal-grass. Hamilton County. A native of Europe.

Subfamily, PANICATAE.

419. Panicum agrostoides Spreng. Agrostis-like Panic-grass. Erie County.
420. Panicum stipitatum Nash. Long Panic-grass. Northeastern Ohio to Lorain, Fairfield, and Columbiana Counties.
421. Panicum virgatum L. Tall, smooth Panic-grass. General.
422. Panicum dichotomiflorum Mx. Spreading Panic-grass. General.
423. Panicum miliaceum L. Millet Panic-grass. Lawrence, Richland, Erie. Introduced.
424. Panicum capillare L. Tumble Panic-grass. General and abundant.
425. Panicum gattingeri Nash. Gattinger's Panic-grass. Rather general.
426. Panicum flexile (Gatt.) Scrib. Wiry Panic-grass. Adams, Champaign, Madison, Franklin, Erie, Cuyahoga.
427. Panicum philadelphicum Bernh. Philadelphia Panic-grass. Ottawa County.
428. Panicum depauperatum Muhl. Starved Panic-grass. Cuyahoga County.
429. Panicum linearifolium Scrib. Linear-leaf Panic-grass. Rather general.
430. Panicum werneri Scrib. Werner's Panic-grass. Lake, Cuyahoga, Franklin, Athens.
431. Panicum bicknellii Nash. Bicknell's Panic-grass. Gallia County.
432. Panicum sphaerocarpon Ell. Round-fruited Panic-grass. Cuyahoga, Summit, Trumbull, Hocking, Scioto.
433. Panicum polyanthes Schultes. Many-flowered Panic-grass. Fairfield, Hocking, Jackson.

434. Panicum dichotomum L. Forked Panic-grass. Rather general; no specimens fro mthe northwestern counties.

435. Panicum microcarpon Muhl. Small-fruited Panic-grass. Cuyahoga, Lorain, Erie, Fairfield, Hocking, Jackson, Adams.

436. Panicum boreale Nash. Northern Panic-grass. Fulton County.

437. Panicum lindheimeri Nash. Lindheimer's Panic-grass. Ashtabula, Hocking.

438. Panicum huachucae Ashe. Hairy Panic-grass. General.

439. Panicum villosissimum Nash. Villous Panic-grass. Cuyahoga, Erie, Licking.

440. Panicum implicatum Scrib. Slender-stemmed Panic-grass. Gallia County.

441. Panicum tsugetorum Nash. Hemlock Panic-grass. Defiance, Summit.

442. Panicum leibergii (Vasey) Scrib. Leiberg's Panic-grass. No specimens.

443. Panicum scribnerianum Nash. Scribner's Panic-grass. Cuyahoga, Erie, Wood, Franklin.

444. Panicum xanthophysum Gr. Slender Panic-grass. Lake County.

445. Panicum ashei Pear. Ashe's Panic-grass. Cuyahoga, Lake, Trumbull, Fairfield.

446. Panicum commutatum Schultes. Variable Panic-grass. Lawrence, Gallia, Fairfield, Wayne.

447. Panicum latifolium L. Broad-leaf Panic-grass. General.

448. Panicum boscii Poir. Bosc's Panic-grass. Warren, Adams, Jackson, Belmont.

448a. Panicum boscii molle (Vas.) Hitch. & Ch. Hamilton, Lawrence, Cuyahoga.

449. Panicum clandestinum L. Hispid Panic-grass. General.

450. Leptaloma cognatum (Schultes) Chase. Fall Witch-grass. From the West. Lake County.

451. Syntherisma filiforme (L.) Nash. Slender Crab-grass. No specimens.

452. Syntherisma ischaemum (Schreb.) Nash. Small Crab-grass. Lorain, Wayne, Auglaize, Fairfield. From Europe.

453. Syntherisma sanguinale (L.) Dulac. Large Crab-grass. General. Naturalized.

454. Echinochloa crus-galli (L.) Beauv. Common Barnyard-grass. General and abundant. Naturalized from Europe.

455. Echinochloa walteri (Pursh.) Nash. Marsh Cockspur-grass. Erie, Lorain, Shelby, Auglaize, Licking.

456. Paspalum muhlenbergii Nash. Muhlenberg's Paspalum. Cuyahoga, Erie, Warren, Hamilton, Scioto, Guernsey.

457. Chaetochloa verticillata (L.) Scrib. Verticillate Foxtail-grass. From Europe. Cuyahoga, Wayne, Jefferson, Franklin, Ross, Montgomery, Warren, Hamilton.

458. Chaetochloa glauca (L.) Scrib. Yellow Foxtail-grass. General. From Europe.

459. Chaetochloa viridis (L.) Scrib. Green Foxtail-grass. General. Naturalized from Europe.

460. Chaetochloa italica (L.) Scrib. Italian Millet. Rather general. Escaped.

461. Cenchrus tribuloides L. Sandbur-grass. Lucas, Wood, Ottawa, Erie, Lorain, Cuyahoga, Franklin, Highland, Gallia.

462. Homalocenchrus virginicus (Willd.) Britt. Virginia Cut-grass. Rather general.

463. Homalocenchrus oryzoides (L.) Poll. Rice Cut-grass. Rather general.

464. Zizania aquatica L. Wild Rice. Erie, Licking, Perry, Hocking.

465. Holcus halapense L. Johnson-grass. Native of Europe. Cuyahoga, Erie, Franklin, Madison

466. Holcus sorghum L. Common Sorghum. Volunteer in Adams County.

467 Sorghastrum nutans (L.) Nash. Indian-grass. Ashtabula, Cuyahoga, Erie, Wyandot, Auglaize, Franklin, Madison, Adams.

468. Miscanthus sinensis Anderss. Chinese Plume-grass. An escape in Lake County.

469. Andropogon furcatus Muhl. Big Bluestem. Rather general.

470. Andropogon virginicus L. Virginia Beard-grass. Gallia, Jackson, Meigs, Athens, Vinton, Hocking, Fairfield, Belmont.

471 Andropogon scoparius Mx. Little Bluestem. (Schizachyrium scoparium (Mx.) Nash). Rather general.

472. Coix lacryma L. Job's-tears. Persistent in Franklin County.

473. Zea mays L. Indian Corn. Spontaneous in Brown, Adams, Scioto, Fayette, Monroe, and Hancock Counties.

Subclass, LILIIFLORAE.

Order, *Liliales.*

**Liliaceae.** Lily Family.

Subfamily, DRACAENATAE.

474. Yucca filamentosa L. Adam's-needle. Escaped in Franklin County.

Subfamily, LILIATAE.

475. Lilium superbum L. Turk's-cap Lily. Erie County—Moseley herbarium).
476. Lilium canadense L. Canada Lily. General.
477. Lilium philadelphicum L. Philadelphia Lily. Fulton, Lucas, Sandusky, (Erie County—Moseley herbarium).
478. Lilium umbellatum Pursh. Western Red Lily. Stark County.
479. Erythronium americanum Ker. Yellow Dog-tooth Lily. General.
480. Erythronium albidum Nutt. White Dog-tooth Lily. General.
481. Hemerocallis fulva L. Common Day-lily. General. Escaped from cultivation.
482. Allium tricoccum Ait. Wild Leek. West central part of state to Delaware and Franklin; also in Lorain, Cuyahoga, and Medina Counties.
483. Allium vineale L. Field Garlic. Franklin, Harrison. From Europe.
484. Allium cepa L. Common Onion. Cultivated. Sometimes persistent.
485. Allium canadense L. Meadow Garlic. General.
486. Allium cernuum Roth. Nodding Onion. General.
487. Quamasia hyacinthina (Raf.) Britt. Wild Hyacinth. General, but rare in eastern Ohio.
488. Ornithogalum umbellatum L. Star-of-Bethlehem. From Europe. Montgomery, Miami, Gallia, Franklin, Auglaize.
489. Muscari botryoides (L.) Mill. Grape-hyacinth. From Europe. Montgomery, Lake.
490. Aletris farinosa L. Colic-root. In counties bordering Lake Erie.

Subfamily, MELANTHATAE.

491. Uvularia sessilifolia L. Sessile-leaf Bellwort. Lucas, Cuyahoga, Portage, Summit, Mahoning, Gallia.

492. Uvularia grandiflora Sm. Large-flowered Bellwort. General.
493. Uvularia perfoliata L. Perfoliate Bellwort. General.
494. Melanthium virginicum L. Virginia Bunchflower. Richland, Wayne.
495. Veratrum woodii Robb. Wood's False-hellebore. Auglaize County.
496. Veratrum viride Ait. American False-hellebore. Ashtabula County.
497. Anticlea elegans (Pursh) Rydb. Glaucous Anticlea. Champaign, Portage, Stark, Highland, Ottawa.
498. Stenanthium robustum Wats. Stout Stenanthium. Fairfield County.
499. Chamaelirium luteum (L.) Gr. Chamaelirium. Northeastern Ohio to Licking County; also in Lawrence County.
500. Triantha glutinosa (Mx.) Baker. Glutinous Triantha. Stark, Champaign.

Subfamily, TRILLIATAE.

501. Trillium grandiflorum (Mx.) Salisb. Large-flowered Trillium. General.
502. Trillium erectum L. Ill-scented Trillium. General.
503. Trillium cernuum L. Nodding Trillium. Auglaize, Champaign, Medina.
504. Trillium declinatum (Gr.) Gleason. Drooping Trillium. No specimens.
505. Trillium undulatum Willd. Painted Trillium. Ashtabula County.
506. Trillium nivale Ridd. Early Trillium. Miami, Clark, Greene, Franklin.
507. Trillium sessile L. Sessile Trillium. General.
508. Trillium recurvatum Beck. Prairie Trillium. Auglaize, Hamilton.
509. Medeola virginiana L. Indian Cucumber-root. General.

Subfamily, CONVALLARIATAE.

510. Streptopus amplexifolius (L.) DC. Clasping-leaf Twisted-stalk. Reported for Ohio.
511. Disporum lanuginosum (Mx.) Nich. Hairy Disporum. Eastern half of state; also in Adams County.

512. Polygonatum commutatum (R. & S.) Dietr. Smooth Solomon's-seal. General.
513. Polygonatum biflorum (Walt.) Ell. Hairy Solomon's-seal. General.
514. Vagnera racemosa (L.) Mor. Panicled False Solomon's-seal. General.
515. Vagnera stellata (L.) Mor. Stellate False Solomon's-seal. Rather general.
516. Vagnera trifolia (L.) Mor. Three-leaf False Solomon's-seal. Fulton, Lorain.
517. Unifolium canadense (Desf.) Greene. False Lily-of-the-valley. General.
518. Clintonia borealis (Ait.) Raf. Yellow Clintonia. Ashtabula County.
519. Clintonia umbellulata (Mx.) Torr. White Clintonia. Harrison, Portage, Wayne.
520. Convallaria majalis L. Lily-of-the-valley. Escaped in Franklin County.
521. Asparagus officinalis L. Asparagus. General. Introduced from Europe.

**Smilaceae.** Smilax Family.

522. Smilax ecirrhata (Engel.) Wats. Upright Smilax. Erie, Ottawa, Wood, Hardin, Preble, Clinton, Brown, Fairfield.
523. Smilax herbacea L. Common Carrion-flower. General.
524. Smilax pseudo-china L. Long-stalked Greenbrier. Erie, Vinton, Brown.
525. Smilax hispida Muhl. Hispid Greenbrier. General.
526. Smilax glauca Walt. Glaucous Greenbrier. Southeastern part of the state to Clermont, Warren, Fairfield, Knox, and Summit Counties; also in Lucas County.
527. Smilax rotundifolia L. Roundleaf Greenbrier. Lawrence, Hocking, Fairfield, Licking, Belmont, Lorain, Cuyahoga.

**Pontederiaceae.** Pickerel-weed Family.

528. Pontederia cordata L. Pickerel-weed. From Licking and Perry northeast; also in Defiance, Fulton, Lucas, and Erie.
529. Heteranthera dubia (Jacq.) MacM. Water-stargrass. Rather general.

**Commelinaceae.** Spiderwort Family.

530. Tradescantia reflexa Raf. Reflexed Spiderwort. Ashtabula, Erie, Mahoning, Richland, Coshocton, Licking, Franklin, Auglaize.
531. Tradescantia virginiana L. Virginia Spiderwort. General as far north as Auglaize and Stark.
532. Tradescantia pilosa Lehm. Zigzag Spiderwort. Hamilton, Clermont, Montgomery.
533. Commelina virginica L. Virginia Day-flower. Clermont, Montgomery, Lake.

**Juncaceae.** Rush Family.

534. Juncus effusus L. Common Rush. General.
535. Juncus balticus Willd. Baltic Rush. Erie County.
536. Juncus gerardi Lois. Gerard's Rush. Cuyahoga County.
537. Juncus dudleyi Wieg. Dudley's Rush. Montgomery, Clinton, Champaign, Delaware, Licking, Tuscarawas.
538. Juncus tenuis Willd. Slender Rush. General.
539. Juncus bufonius L. Toad Rush. Williams, Lucas, Lorain, Licking.
540. Juncus monostichus Bartl. One-ranked Rush. Trumbull County.
541. Juncus aristulatus Mx. Small-headed Grass-leaf Rush. Fairfield, Wayne, Summit.
542. Juncus marginatus Rostk. Grass-leaf Rush. Cuyahoga County.
543. Juncus alpinus Vill. Richardson's Rush. Cuyahoga County.
544. Juncus articulatus L. Jointed Rush. Cuyahoga County.
545. Juncus torreyi Cov. Torrey's Rush. Adams, Madison, Wood, Erie, Cuyahoga.
546. Juncus nodosus L. Knotted Rush. Madison, Franklin, Cuyahoga, Erie.
547. Juncus brachycephalus (Engelm.) Buch. Small-headed Rush. Erie, Cuyahoga, Franklin, Madison, Champaign.
548. Juncus acuminatus Mx. Sharp-fruited Rush. General.
549. Juncus canadensis J. Gay. Canada Rush. Cuyahoga, Geauga, Licking, Madison, Auglaize.
550. Juncus scirpoides Lam. Scirpus-like Rush. Erie County.
551. Juncoides carolinae (Wats.) Ktz. Hairy Wood-rush. Lucas, Cuyahoga, Trumbull, Mahoning, Hocking.
552. Juncoides campestre (L.) Ktz. Common Wood-rush. General.

**Xyridaceae.** Yellow-eyed-grass Family.

553. Xyris flexuosa Muhl. Slender Yellow-eyed-grass. Portage, Geauga.

**Eriocaulaceae.** Pipewort Family.

554. Eriocaulon septangulare With. Seven-angled Pipewort. Summit County.

Order, *Iridales.*

**Amaryllidaceae.** Amaryllis Family.

555. Manfreda virginica (L.) Salisb. False Aloe. Lawrence County.
556. Hypoxis hirsuta (L.) Cov. Yellow Stargrass. General.

**Iridaceae.** Iris Family.

557. Iris versicolor L. Large Blue-flag. General.
558. Iris cristata Ait. Crested Dwarf Iris. Lawrence, Adams, Scioto, Pike, Ross, Jackson, Vinton, Hocking, Cuyahoga, Trumbull.
559. Gemmingia chinensis (L.) Ktz. Blackberry-lily. From Asia. Franklin County.
560. Crocus verna L. Crocus. Escaped in Lake County.
561. Sisyrinchium angustifolium Mill. Pointed Blue-eyed-grass. Rather general.
562. Sisyrinchium graminoides Bickn. Stout Blue-eyed-grass. General.

**Dioscoreaceae.** Yam Family.

563. Dioscorea villosa L. Wild Yam. General.
563.1. Dioscorea bulbifera L. Air Potato (Yam). Escaped from gardens in Madison County.

Order, *Orchidales.*

**Orchidaceae.** Orchid Family.

Subfamily, CYPRIPEDIATAE.

564. Cypripedium reginae Walt. Showy Lady's-slipper. Fulton, Champaign, Lucas, Geauga, Portage, Muskingum.
565. Cypripedium candidum Willd. White Lady's-slipper. Wyandot, Erie, Montgomery.

566. Cypripedium parviflorum Salisb. Yellow Lady's-slipper. General.
567. Fissipes acaulis (Ait.) Small. Moccasin-flower. Medina, Portage, Hocking, Fairfield, Stark, Cuyahoga.

Subfamily, ORCHIDATAE.

568. Galeorchis spectabilis (L.) Rydb. Showy Orchis. General.
569. Perularia flava (L.) Farw. Tubercled Orchis. General.
570. Coeloglossum bracteatum (Willd.) Parl. Long-bracted Orchis. Lucas, Lorain, Medina, Portage, Franklin, Butler, Auglaize.
571. Gymnadeniopsis clavellata (Mx.) Rydb. Green Wood-orchis. Geauga, Trumbull, Portage, Summit, Richland, Licking, Champaign.
572. Limnorchis hyperborea (L.) Rydb. Tall Bog-orchis. Stark County.
573. Lysias orbiculata (Pursh.) Rydb. Large Roundleaf Orchis. Cuyahoga, Geauga, Wayne.
574. Lysias hookeriana (Gr.) Rydb. Hooker's Orchis. Medina County.
575. Blephariglottis ciliaris (L.) Rydb. Yellow Fringed-orchis. Fulton County.
576. Blephariglottis blephariglottis (Willd.) Rydb. White Fringed-orchis. Geauga, Portage.
577. Blephariglottis lacera (Mx.) Farw. Ragged Fringed-orchis. Cuyahoga, Portage, Crawford, Richland, Wayne, Holmes, Stark, Licking, Fairfield.
578. Blephariglottis leucophaea (Nutt.) Farw. Prairie Fringed-orchis. Auglaize County.
579. Blephariglottis psycodes (L.) Rydb. Smaller Purple Fringed-orchis. Rather general.
579a. Blephariglottis psycodes grandiflora (Bigel.). Portage County (R. J. Webb).
580. Blephariglottis peramoena (Gr.) Rydb. Fringeless Purple Orchis. Perry, Gallia, Clermont, Wayne, Hocking.
581. Pogonia ophioglossoides (L.) Ker. Rose Pogonia. Lucas, Cuyahoga, Geauga, Ashland, Portage, Richland, Licking, Lorain, Holmes.
582. Isotria verticillata (Willd.) Raf. Whorled Isotria. Defiance, Cuyahoga, Geauga, Medina, Coshocton, Fairfield.

583. Triphora trianthophora (Sw.) Rydb. Nodding Triphora. Huron, Cuyahoga, Wayne, Summit, Stark, Licking, Franklin, Ross, Clark.

584. Arethusa bulbosa L. Arethusa. Licking, Portage.

585. Limodorum tuberosum L. Limodorum. Fulton, Lucas, Erie, Geauga, Portage, Summit, Ashland, Stark, Clark, Fairfield, Licking, Wayne.

586. Ibidium strictum (Rydb.) House. Hooded Lady's-tresses. Ashtabula County.

587. Ibidium plantagineum (Raf.) House. Broadleaf Lady's-tresses. Medina, Portage.

588. Ibidium cernuum (L.) House. Nodding Lady's-tresses. Erie, Lorain, Cuyahoga, Medina, Portage, Stark, Lake, Licking.

589. Ibidium ovale (Lindl.) House. Small-flowered Lady's-tresses. No specimens.

590. Ibidium praecox (Walt.) House. Grass-leaf Lady's-tresses. Wayne County.

591. Ibidium beckii (Lindl.) House. Little Lady's-tresses. Fairfield County.

592. Ibidium gracile (Bigel.) House. Slender Lady's-tresses. Erie, Cuyahoga, Lake, Licking, Muskingum, Fairfield, Hocking, Adams, Gallia, Morgan.

593. Peramium pubescens (Willd.) MacM. Downy Rattlesnake-plantain. Adams, Hocking, Lake, Fairfield, Highland, Wayne, Noble, Portage.

594. Malaxis unifolia Mx. Green Addermouth. Fairfield, Hocking, Wayne.

595. Liparis liliifolia (L.) Rich. Large Twayblade. Portage, Franklin, Fairfield, Clark, Wayne.

596. Liparis loeselii (L.) Rich. Fen Twayblade. Champaign, Cuyahoga, Summit, Stark.

597. Tipularia unifolia (Muhl.) B. S. P. Crane-fly Orchis. Medina, (Lorain, Cuyahoga—Oberlin College Herbarium).

598. Aplectrum hyemale (Muhl.) Torr. Putty-root. General.

599. Corallorrhiza corallorrhiza (L.) Karst. Early Coral-root. No specimens.

600. Corallorrhiza maculata Raf. Large Coral-root. Erie, Huron, Cuyahoga, Wayne, Fairfield, Franklin, Gallia, Noble.

601. Corallorrhiza wisteriana Conrad. Wister's Coral-root. Hamilton, Lawrence.
602. Corallorrhiza odontorhiza (Willd.) Nutt. Small-flowered Coral-root. Erie, Cuyahoga, Stark, Licking, Fairfield, Madison.

Class, DICOTYLAE. Dicotyls.

Subclass, THALAMIFLORAE.

Order, *Ranales*.

**Magnoliaceae.** Magnolia Family.

603. Magnolia acuminata L. Cucumber Magnolia. Eastern half of state, west to Lorain and Madison Counties.
604. Magnolia tripetala L. Umbrella Magnolia. Scioto County.
605. Liriodendron tulipifera L. Tuliptree. General.

**Anonaceae.** Custard-apple Family.

606. Asimina triloba (L.) Dunal. Papaw. General.

**Ranunculaceae.** Crowfoot Family.

607. Ranunculus abortivus L. Kindney-leaf Crowfoot. General and abundant.
608. Ranunculus micranthus Nutt. Rock Crowfoot. Clermont County.
609. Ranunculus sceleratus L. Celery-leaf Crowfoot. Rather general.
610. Ranunculus recurvatus Poir. Hooked Crowfoot. General and abundant.
611. Ranunculus acris L. Tall Buttercup. Rather general except in the southern part. From Europe.
612. Ranunculus bulbosus L. Bulbous Buttercup. Columbiana County. From Europe.
613. Ranunculus pennsylvanicus L. f. Bristly Buttercup. Lucas, Ottawa, Cuyahoga, Lake, Wayne, Licking, Fairfield, Perry.
614. Ranunculus repens L. Creeping Buttercup. Scioto, Columbiana. From Europe.
615. Ranunculus septentrionalis Poir. Swamp Buttercup. General and abundant.
616. Ranunculus hispidus Mx. Hispid Buttercup. General.
617. Ranunculus fascicularis Muhl. Tufted Buttercup. Lucas, Ottawa, Cuyahoga.

618. Ranunculus arvensis L. Corn Crowfoot. No specimens. From Europe.
619. Ranunculus obtusiusculus Raf. Lance-leaf Buttercup. Jackson, Franklin, Licking, Erie, Lorain, Cuyahoga, Lake, Ashtabula.
620. Ranunculus delphinifolius Torr. Yellow Water-crowfoot. Northwestern fourth of state to Huron and Madison Counties; also in Ashtabula County.
621. Ficaria ficaria (L.) Karst. Golden-cup. Lake County. From Europe.
622. Batrachium trichophyllum (Chaix.) Schultz. White Water-crowfoot. Rather general.
623. Batrachium circinatum (Sibth.) Rchb. Circinate White Water-crowfoot. Licking, Defiance.
624. Trollius laxus Salisb. American Globe-flower. Columbiana, Stark.
625. Helleborus viridis L. Green Hellebore. Gallia, Miami, Franklin, Stark. From Europe.
626. Nigella damascena L. Love-in-a-mist. Hamilton County. (Erie County—Moseley Herbarium.) Escaped from gardens.
627. Coptis trifolia (L.) Salisb. Gold-thread. Defiance, Portage, Summit, Stark, Geauga.
628. Aquilegia canadensis L. Wild Columbine. General.
629. Aquilegia vulgaris L. European Columbine. Escaped in Fulton County.
630. Aconitum noveboracense Gr. New York Monkshood. Summit, Portage.
631. Delphinium tricorne Mx. Dwarf Larkspur. Southern half of the state; also in Columbiana County.
632. Delphinium exaltatum Ait. Tall Larkspur. Stark, Franklin.
633. Delphinium ajacis L. Garden Larkspur. General. Naturalized from Europe.
634. Anemone cylindrica Gr. Long-fruited Anemone. Wood, Ottawa, Erie.
635. Anemone virginiana L. Virginia Anemone. General.
636. Anemone canadensis L. Canada Anemone. General.
637. Anemone quinquefolia L. Wind-flower. General except southern and southeastern parts of the state.
638. Hepatica hepatica (L.) Karst. Roundlobed Liver-leaf. General.

639. Hepatica acutiloba DC. Sharplobed Liver-leaf. General.
640. Clematis virginiana L. Virginia Virgin's-bower. General.
641. Viorna viorna (L.) Small. Leather-flower. Southern half of Ohio; also in Auglaize County.
642. Caltha palustris L. Marsh-marigold. General.
643. Hydrastis canadensis L. Golden-seal. General.
644. Actaea rubra (Ait.) Willd. Red Baneberry. Erie, Sandusky.
645. Actaea alba (L.) Mill. White Baneberry. General.
646. Cimicifuga racemosa (L.) Nutt. Black Cohosh. Eastern half of state to Erie, Fairfield, and Clermont Counties.
647. Syndesmon thalictroides (L.) Hoffm. Rue-anemone. General and abundant.
648. Isopyrum biternatum (Raf.) T. & G. False Rue-anemone. Southwestern fourth of state; also in Cuyahoga County.
649. Thalictrum dioicum L. Early Meadow-rue. General.
650. Thalictrum dasycarpum Fisch & Lall. Purplish Meadow-rue. General.
651. Thalictrum polygamum Muhl. Fall Meadow-rue. Rather general.

**Parnissiaceae.** Grass-of-Parnassus Family.

652. Parnassia caroliniana Mx. Carolina Grass-of-Parnassus. Rather general.

**Ceratophyllaceae.** Hornleaf Family.

653. Ceratophyllum demersum L. Hornleaf. General.

**Berberidaceae.** Barberry Family.

654. Podophyllum peltatum L. May-apple. General and abundant.
655. Jeffersonia diphylla (L.) Pers. Twinleaf. General.
656. Caulophyllum thalictroides (L.) Mx. Blue Cohosh. General.
657. Berberis vulgaris L. Common Barberry. Escaped rather generally.
658. Odostemon aquifolium (Pursh.) Rydb. Tailing Mahonia. Escaped in Lake County.

**Menispermaceae.** Moonseed Family.

659. Menispermum canadense L. Moonseed. General and abundant.

**Lauraceae.** Laurel Family.

660. Sassafras sassafras (L.) Karst. Sassafras. General.
661. Benzoin aestivale (L.) Nees. Spicebush. General.

Order, *Sarraceniales.*

**Sarraceniaceae.** Pitcher-plant Family.

662. Sarracenia purpurea L. Pitcher-plant. Geauga, Summit, Ashtabula, Wayne, Richland, Defiance, Williams.

**Droseraceae.** Sundew Family.

663. Drosera rotundifolia L. Roundleaf Sundew. Licking, Wayne, Portage, Stark, Geauga, Ashtabula.
664. Drosera intermedia Hayne. Spatulate Sundew. Wayne County.

Order, *Brassicales.*

**Papaveraceae.** Poppy Family.

665. Papaver somniferum L. Opium Poppy. No specimens. From Europe.
666. Papaver rhoeas L. Field Poppy. Ashtabula County. From Europe.
667. Papaver dubium L. Corn Poppy. No specimens. From Europe.
668. Papaver argemone L. Rough-fruited Poppy. (Erie County-Moseley Herbarium.) From Europe.
669. Argemone mexicana L. Mexican Prickly-poppy. Franklin County. From tropical America.
670. Sanguinaria canadensis L. Bloodroot. General and abundant.
671. Stylophorum diphyllum (Mx.) Nutt. Yellow Poppy. Southern half of state.
672. Macleya cordata (Willd.) R. Br. Macleya. Escaped in Madison and Franklin Counties.
673. Chelidonium majus L. Celandine. General. From Europe.

**Fumariaceae.** Fumitory Family.

674. Bicuculla cucullaria (L.) Millsp. Dutchman's-breeches. General.
675. Bicuculla canadensis (Goldie) Millsp. Squirrel-corn. General.

676. Adlumia fungosa (Ait.) Greene. Climbing Fumitory. Lorain, Cuyahoga, Lake, Summit, Belmont.

677. Capnoides sempervirens (L.) Borck. Pink Corydalis. Fairfield, Knox, Portage.

678. Capnoides flavulum (Raf.) Ktz. Pale Corydalis. Southwestern fourth of state; also in Ottawa and Erie Counties.

679. Capnoides aureum (Willd.) Ktz. Golden Corydalis. (Ottawa County—Moseley Herbarium.)

680. Fumaria officinalis L. Common Fumitory. Columbiana County. From Europe.

681. Fumaria parviflora Lam. Small-flowered Fumitory. Introduced in Lake County.

**Brassicaceae.** Mustard Family.

682. Berteroa incana (L.) DC. Hoary Berteroa. No specimens. From Europe.

683. Koniga maritima (L.) R. Br. Sweet Alyssum. Erie County. Escaped.

684. Alyssum alyssoides L. Yellow Alyssum. Sandusky County. From Europe.

685. Draba verna L. Vernal Whitlow-grass. Southern half of state; also in Portage County. From Europe.

686. Draba caroliniana Walt. Carolina Whitlow-grass. Adams, Clark, Erie, Ottawa.

687. Camelina sativa (L.) Crantz. Common False-flax. Sandusky, Auglaize, Miami, Montgomery, Franklin. From Europe.

688. Camelina microcarpa Andrz. Small-fruited False-flax. Clark County. From Europe.

689. Bursa bursa-pastoris (L.) Britt. Shepherd's-purse. General and abundant. From Europe.

690. Neslia paniculata (L.) Desv. Ball-mustard. Escaped in Lake County.

691. Armoracia armoracia (L.) Britt. Horseradish. General. From Europe.

692. Neobeckia aquatica (Eat.) Britt. Lake Water-cress. Lucas, Coshocton, Licking, Perry, Madison.

693. Sisymbrium nasturtium-aquaticum L. True Water-cress. Rather general. From Europe.

694. Radicula hispida (Desv.) Britt. Hispid Yellow-cress. Monroe, Shelby, Logan, Ottawa, Erie, Huron, Cuyahoga, Summit.
695. Radicula palustris (L.) Moench. Marsh Yellow-cress. General.
696. Radicula sylvestris (L.) Druce. Creeping Yellow-cress. Lucas, Erie, Cuyahoga. From Europe.
697. Lepidium ruderale L. Roadside Peppergrass. No specimens. From Europe.
698. Lepidium virginicum L. Virginia Peppergrass. General and abundant.
699. Lepidium densiflorum Schrad. Wild Peppergrass. Auglaize, Champaign, Franklin, Fayette, Wayne, Lorain, Cuyahoga, Lake.
700. Lepidium draba L. Hoary Peppergrass. Lucas County. From Europe.
701. Lepidium campestre (L.) R. Br. Field Peppergrass. Rather general. From Europe.
702. Carara didyma (L.) Britt. Lesser Wart-cress. Lake County. Escaped.
703. Thlaspi arvense L. Field Penny-cress. Cuyahoga, Henry. From Europe.
704. Myagrum perfoliatum L. Myagrum. Lake County. From Europe.
705. Alliaria alliaria (L.) Britt. Garlic Mustard. (Erie County—Moseley Herbarium.) From Europe.
706. Sophia pinnata (Walt.) Howell. Pinnate Tanzy-mustard. Hamilton, Montgomery, Miami, Ottawa, Jackson.
707. Sophia incisa (Eng.) Greene. Western Tanzy-mustard. Miami, Portage.
708. Cheirinia cheiranthoides (L.) Link. Worm-seed Mustard. Hamilton, Lucas, Lake, Portage.
709. Cheirinia repanda (L.) Link. Repand Cheirinia. Logan, Erie. From Europe.
710. Cheirinia aspera (DC.) Britt. Western Cheirinia. Franklin County.
711. Erysimum officinale L. Hedge-mustard. General and abundant. From Europe.
712. Norta altissima (L.) Britt. Tall Hedge-mustard. Lake, Cuyahoga, Erie, Ottawa, Wayne, Jackson, Greene, Belmont, Portage. From Europe.

713. Norta irio (L.) Britt. Longleaf Hedge-mustard. Portage County. Introduced.
714. Conringia orientalis (L.) Dum. Hare's-ear Mustard. Lake, Cuyahoga, Geauga. From Europe.
715. Hesperis matronalis L. Dame's Rocket. Hamilton, Franklin, Portage. From Europe.
716. Arabidopsis thaliana (L.) Britt. Mouse-ear Cress. Clinton, Montgomery, Lucas, Asthtabula. From Europe.
717. Barbarea barbarea (L.) MacM. Yellow Winter-cress. General. From Europe.
718. Barbarea stricta Andrz. Erect Winter-cress. Erie County. From Europe.
719. Barbarea verna (Mill.) Aschers. Early Winter-cress. Belmont, Portage, Harrison, Preble. From Europe.
720. Iodanthus pinnatifidus (Mx.) Steud. Purple Rocket. Rather general.
721. Arabis dentata T. & G. Toothed Rock-cress. Rather general.
722. Arabis patens Sull. Spreading Rock-cress. Franklin County.
723. Arabis hirsuta (L.) Scop. Hairy Rock-cress. Rather general.
724. Arabis glabra (L.) Bernh. Tower Mustard. Hamilton, Franklin, Auglaize, Lucas, Richland, Cuyahoga, Geauga, Belmont.
725. Arabis laevigata (Muhl.) Poir. Smooth Rock-cress. General.
726. Arabis canadensis L. Sickle-pod Rock-grass. General.
727. Arabis virginica (L.) Trel. Virginia Rock-cress. Clermont, Lawrence, Clark.
728. Arabis lyrata L. Lyre-leaf Rock-cress. Pike, Muskingum, Auglaize, Wood, Erie.
729. Arabis drummondii Gr. Drummond's Rock-cress. No specimens.
730. Arabis brachycarpa (T. & G.) Britt. Purple Rock-cress. Erie. Ottawa.
731. Cardamine douglassii (Torr.) Britt. Purple Bitter-cress. General and abundant.
732. Cardamine bulbosa (Schreb.) B. S. P. Bulbous Bitter-cress. General.
733. Cardamine rotundifolia Mx. Roundleaf Bitter-cress. Belmont, Noble.
734. Cardamine pratensis L. Meadow Bitter-cress. Portage County.
735. Cardamine hirsuta L. Hairy Bitter-cress. Lake County.

736. Cardamine pennsylvanica Muhl. Pennsylvania Bitter-cress. General.

737. Cardamine arenicola Britt. Sand Bitter-cress. Lake County.

738. Cardamine parviflora L. Small-flowered Bitter-cress. Lawrence, Hocking, Fairfield, Delaware.

739. Dentaria dipylla Mx. Two-leaf Toothwort. Eastern half of state.

740. Dentaria maxima Nutt. Large Toothwort. No specimens.

741. Dentaria heterophylla Nutt. Slender Toothwort. Auglaize, Hocking, Vinton, Belmont, Clermont.

742. Dentaria laciniata Muhl. Cutleaf Toothwort. General and abundant.

743. Sinapis alba L. White Mustard. Lucas County. From Europe.

744. Sinapis arvensis L. Corn Mustard. General except in the southern part. From Europe.

745. Brassica nigra (L.) Koch. Black Mustard. General and abundant. From Europe.

746. Brassica juncea (L.) Cosson. Indian Mustard. Wayne, Portage. From Asia.

747. Brassica campestris L. Common Turnip. Miami, Auglaize, Franklin, Wayne. From Europe.

748. Brassica napus L. Rape. Franklin County. Introduced.

749. Brassica oleracea L. Cabbage. No specimens. Spontaneous after cultivation.

750. Diplotaxis muralis (L.) DC. Sand Rocket. Cuyahoga County. From Europe.

751. Raphanus raphanistrum L. Wild Radish. Lake County. From Europe.

752. Raphanus sativus L. Garden Radish. Rather general. Spontaneous after cultivation.

753. Cakile edentula (Bigel.) Hook. Sea Rocket. Ashtabula, Lake, Cuyahoga, Erie.

**Capparidaceae.** Caper Family.

754. Polanisia graveolens Raf. Clammy-weed. Hamilton, Clermont, Warren, Montgomery, Greene, Ross, Monroe, Erie, Cuyahoga.

755. Cleome spinosa L. Spider-flower. Montgomery, Cuyahoga. From tropical America.

**Resedaceae.** Mignonette Family.

756. Reseda luteola L. Dyer's Mignonette. Licking, Belmont. From Europe.

757. Reseda alba L. White Mignonette. Cuyahoga County. From Europe.

Order, *Geraniales.*

**Geraniaceae.** Geranium Family.

758. Geranium maculatum L. Wild Crane's-bill. General and abundant.

759. Geranium columbinum L. Long-stalked Crane's-bill. Lake County. From Europe.

760. Geranium carolinianum L. Carolina Crane's-bill. General.

761. Geranium molle L. Dove's-foot Crane's-bill. Madison, Lake. From Europe.

762. Geranium pusillum L. Small-flowered Crane's-bill. Cuyahoga, Lake, Ashtabula. From Europe.

763. Robertiella robertiana (L.) Hanks. Herb-Robert. North central counties.

764. Erodium cicutarium (L.) L'Her. Stork's-bill. Auglaize, Lake. From Europe.

**Oxalidaceae.** Wood-sorrel Family.

765. Oxalis grandis Small. Great Wood-sorrel. General except in the northwestern part of the state.

766. Oxalis cymosa Small. Tall Wood-sorrel. General and abundant.

767. Oxalis stricta L. Upright Wood-sorrel. General.

768. Oxalis brittoniae Small. Britton's Wood-sorrel. Franklin, Lake.

769. Oxalis rufa Small. Red Wood-sorrel. Franklin, Lake.

770. Oxalis corniculata L. Procumbent Wood-sorrel. Monroe, Franklin, Lake. From tropical America.

771. Oxalis violacea L. Violet Wood-sorrel. Rather general.

**Limnanthaceae.** False-mermaid Family.

772. Floerkea proserpinacoides Willd. False-mermaid. Rather general.

**Linaceae.** Flax Family.

773. Linum usitatissimum L. Common Flax. Rather general. Introduced.
774. Linum perenne L. Perennial Flax. Escaped in Lake County.
775. Linum virginianum L. Virginia Flax. Eastern half of state to Erie, Franklin, and Adams Counties.
776. Linum medium (Planch.) Britt. Stiff Flax. Erie County.
777. Linum sulcatum Ridd. Grooved Flax. Erie County.

**Balsaminaceae.** Jewel-weed Family.

778. Impatiens pallida Nutt. Pale Touch-me-not. General.
779. Impatiens biflora Walt. Spotted Touch-me-not. General and abundant.

**Rutaceae.** Rue Family.

780. Zanthoxylum americanum Mill. Prickly-ash. General in western Ohio as far east as Huron and Licking Counties.
781. Ptelea trifoliata L. Hoptree. General.

**Simarubaceae.** Ailanthus Family.

782. Ailanthus gladulosa Desf. Tree-of-heaven. General. Introduced.

**Polygalaceae.** Milkwort Family.

783. Polygala cruciata L. Crossleaf Milkwort. Gallia, Lucas.
784. Polygala verticillata L. Whorled Milkwort. General; no specimens from the western part of the state.
785. Polygala ambigua Nutt. Loose-spiked Milkwort. Rather general.
786. Polygala viridescens L. Purple Milkwort. General.
787. Polygala senega L. Seneca Snakeroot. Rather general.
788. Polygala polygama Walt. Racemed Milkwort. Ashtabula, Cuyahoga, Lucas.
789. Polygala paucifiora Willd. Fringed Milkwort. Stark County.

**Euphorbiaceae.** Spurge Family.

790. Phyllanthus carolinensis Walt. Carolina Phyllanthus. Hamilton, Warren.
791. Croton capitatus Mx. Capitate Croton. Hamilton, Franklin.

792. Croton monanthogynus Mx. Single-fruited Croton. Franklin County.
793. Acalypha virginica L. Virginia Three-seeded Mercury. General.
794. Acalypha gracilens Gr. Slender Three-seeded Mercury. Rather general.
795. Acalypha ostryaefolia Ridd. Hornbeam Three-seeded Mercury. Washington County.
796. Mercurialis annua L. Mercury. Lake County. Introduced.
797. Ricinus communis L. Castor-oil-plant. Erie, Ottawa, Franklin. Escaped.
798. Poinsettia dentata (Mx.) Small. Toothed Spurge. Lake, Cuyahoga, Ottawa, Lucas, Franklin, Greene, Warren, Hamilton.
799. Tithymalus lathyrus (L.) Hill. Caper Spurge. Hocking County. From Europe.
800. Tithymalus obtusatus (Pursh) K. & G. Bluntleaf Spurge. Lucas, Wyandot, Auglaize, Jackson, Hamilton.
801. Tithymalus platyphyllus (L.) Hill. Broadleaf Spurge. Ashtabula, Cuyahoga. From Europe.
802. Tithymalus helioscopia (L.) Hill. Sun Spurge. Lake County. From Europe.
803. Tithymalus cyparissias (L.) Hill. Cypress Spurge. General. From Europe.
804. Tithymalus peplus (L.) Hill. Petty Spurge. Clark, Erie, Summit, Lake. From Europe.
805. Tithymalus commutatus (Eng.) K. & G. Tinted Spurge. General.
806. Tithymalus corollata (L.) K. & G. Flowering Spurge. General and abundant.
807. Dichrophyllum marginatum (Pursh) K. & G. Snow-on-the-mountain. Lake, Cuyahoga, Erie, Auglaize, Franklin, Clark, Montgomery, Hamilton. From the West.
808. Chamaesyce preslii (Guss.) Arth. Nodding Spurge. General and abundant.
809. Chamaesyce rafinesqui (Greene) Small. Hairy Spurge. Defiance, Vinton.
810. Chamaesyce humistrata (Eng.) Small. Hairy Spreading Spurge. Cuyahoga, Erie, Belmont, Champaign.
811. Chamaesyce maculata (L.) Small. Spotted Spurge. Rather general.

812. Chamaesyce polygonifolia (L.) Small. Knotweed Spurge. Erie, Cuyahoga, Lake.
813. Chamaesyce serpens. (H. B. K.) Small. Roundleaf Spurge. Ottawa County.

**Callitrichaceae.** Water-starwort Family.

814. Callitriche austini Eng. Terrestrial Water-starwort. Cuyahoga, Clermont.
815. Callitriche palustris L. Vernal Water-starwort. Auglaize, Lorain, Trumbull.
816. Callitriche heterophylla Pursh. Larger Water-starwort. Cuyahoga County.

Order, *Malvales.*

**Malvaceae.** Mallow Family.

817. Malva sylvestris L. High Mallow. Cuyahoga, Auglaize. From Europe.
818. Malva rotundifolia L. Roundleaf Mallow. General and abundant. From Europe.
819. Malva verticillata L. Curled Mallow. No specimens. From Europe.
820. Malva alcea L. European Mallow. Escaped in Cuyahoga County. From Europe.
821. Malva moschata L. Musk Mallow. Northern part of the state, as far south as Muskingum County. From Europe.
822. Callirhoe involucrata (T. & G.) Gr. Purple Poppy-mallow. A waif in Franklin County.
823. Althaea officinalis L. Marsh-mallow. A waif in Scioto County.
824. Althaea rosea L. Hollyhock. Lucas, Erie, Madison, Brown, Montgomery, Scioto. Escaped from cultivation.
825. Sida spinosa L. Prickly Sida. Rather general. From the tropics.
826. Sida hermaphrodita (L.) Rusby. Tall Sida. No specimens.
827. Napaea dioica L. Glade-mallow. Defiance, Clark, Madison, Franklin, Fairfield, Highland.
828. Abutilon abutilon (L.) Rusby. Velvet-leaf. General and abundant. From Asia.
829. Hibiscus moscheutos L. Swamp Rose-mallow. Ashtabula, Cuyahoga, Erie, Wayne, Licking, Perry.

830. Hibiscus militaris Cav. Halberd-leaf Rose-mallow. Lucas, Paulding, Auglaize, Defiance, Shelby, Franklin.
831. Hibiscus trionum L. Bladder Ketmia. General. From Europe.

**Tiliaceae.** Linden Family.

832. Tilia americana L. American Linden. General and abundant.
833. Tilia heterophylla Vent. White Linden. Hamilton, Scioto.
834. Tilia michauxii Nutt. Michaux's Linden. No specimens.

Order, *Violales.*

**Hypericaceae.** St. John's-wort Family.

835. Hypericum ascyron L. Great St. John's-wort. Rather general.
836. Hypericum kalmianum L. Kalm's St. John's-wort. Ottawa, Erie, Summit.
837. Hypericum prolificum L. Shrubby St. John's-wort. Rather general.
838. Hypericum perforatum L. Common St. John's-wort. General. From Europe.
839. Hypericum punctatum Lam. Spotted St. John's-wort. General.
840. Hypericum cistifolium Lam. Round-podded St. John's-wort. Montgomery, Clermont, Franklin.
841. Hypericum ellipticum Hook. Elliptic-leaf St. John's-wort. Lake County.
842. Hypericum virgatum Lam. Virgate St. John's-wort. Jackson County.
843. Hypericum boreale (Britt.) Bickn. Northern St. John's-wort. Geauga, Defiance, Wayne.
844. Hypericum mutilum L. Small-flowered St. John's-wort. General.
845. Hypericum gymnanthum Eng. & Gr. Clasping-leaf St. John's-wort. Erie, Ottawa.
846. Hypericum majus (Gr.) Britt. Large Canadian St. John's-wort. (Erie County—Moseley Herbarium.)
847. Hypericum canadense L. Canadian St. John's-wort. (Erie County—Moseley Herbarium.)
848 Hypericum drummondii (Grev. & Hook.) T. & G. Drummond's St. John's-wort. Hamilton, Clermont, Ashtabula, Hocking.
849. Sarothra gentianoides L. Orange-grass. Erie, Gallia, Scioto.
850. Triadenum virginicum (L.) Raf. Marsh St. John's-wort. Cuyahoga, Geauga, Erie, Huron, Wayne, Licking.

851. Ascyrum hypericoides L. St. Andrew's-cross. Hamilton, Scioto, Lawrence, Gallia, Jackson, Hocking, Fairfield.

**Cistaceae.** Rock-rose Family.

852. Crocanthemum majus (L.) Britt. Hoary Frostweed. Lucas, Portage, Fairfield.
853. Crocanthemum canadense (L.) Mx. Canada Frostweed. Erie, Lucas, Wood.
854. Lechea minor L. Thyme-leaf Pinweed. Jefferson, Hocking, Perry.
855. Lechea racemulosa Mx. Oblong-fruited Pinweed. Adams, Scioto, Jackson, Hocking, Fairfield, Licking, Lucas.
856. Lechea villosa Ell. Hairy Pinweed. Summit, Wayne, Erie, Lucas.
857. Lechea tenuifolia Mx. Narrow-leaf Pinweed. Lucas.
858. Lechea leggettii Britt & Holl. Leggett's Pinweed. No specimens.
859. Lechea stricta Legg. Prairie Pinweed. Portage County.

**Violaceae.** Violet Family.

860. Cubelium concolor (Forst.) Raf. Green Violet. Southern half of state to Auglaize, Licking, and Belmont Counties; also in Lake County.
861. Viola canadensis L. Canada Violet. Southeastern half of state; from Huron to Fairfield and Hamilton Counties.
862. Viola eriocarpa Schw. Smooth Yellow Violet. General.
863. Viola pubescens Ait. Hairy Yellow Violet. General.
864. Viola hastata Mx. Halberd-leaf Yellow Violet. Cuyahoga, Lake, Portage, Columbiana, Belmont.
865. Viola striata Ait. Striped Violet. General and abundant.
866. Viola conspersa Reich. American Dog Violet. Lucas, Wyandot, Lorain, Portage, Trumbull.
867. Viola rostrata Pursh. Long-spurred Violet. Rather general.
868. Viola rafinesquii Greene. Wild Pansy. Hamilton, Montgomery, Miami, Pike, Ross, Franklin, Ottawa, Erie, Lake.
869. Viola tricolor L. Garden Pansy. Cuyahoga, County. From Europe.
870. Viola odorata L. Sweet Violet. Lake, Franklin. From Europe.
871. Viola rotundifolia Mx. Roundleaf Violet. Ashtabula, Cuyahoga, Tuscarawas, Hocking.

872. Viola blanda Willd. Sweet White Violet. Rather general.
873. Viola pallens (Banks) Brain. Woodland White Violet. Cuyahoga, Hancock, Fairfield, Vinton.
874. Viola lanceolata L. Lanceleaf Violet. Lake, Fairfield.
875. Viola affinis Le C. Thinleaf Blue Violet. General and abundant.
876. Viola papilonacea Pursh. Common Blue Violet. General and abundant.
877. Viola hirsutula Brain. Southern Wood Violet. Hocking, Fairfield.
878. Viola sororia Willd. Woolly blue Violet. Lake, Portage, Belmont, Wood Warren,
879. Viola palmata L. Early Blue Violet. General and abundant.
880. Viola triloba Schw. Three-lobed Violet. Lake County.
881. Viola emarginata (Nutt.) Le Conte. Triangle-leaf Violet. Lake County.
882. Viola pedatifida Don. Larkspur Violet. Ottawa, Auglaize.
883. Viola fimbriatula Sm. Ovate-leaf Violet. Wood, Licking, Jefferson, Wayne, Portage, Cuyahoga, Lake.
884. Viola sagittata Ait. Arrowleaf Violet. Franklin, Fulton, Erie, Lorain, Cuyahoga.
885. Viola pedata L. Birdfoot Violet. Lawrence, Scioto.

**Passifloraceae.** Passionflower Family.

886. Passiflora lutea L. Yellow Passion-flower. Southern half of state to Darke and Franklin Counties.

Subclass, CENTROSPERMAE.

Order, *Caryophyllales.*

**Caryophyllaceae.** Pink Family.

Subfamily, ALSINATAE.

887. Sagina procumbens L. Procumbent Pearlwort. Lake, Gallia. From Europe.
888. Sagina decumbens (Ell.) T. & G. Decumbent Pearlwort. Lawrence County.
889. Arenaria serpyllifolia L. Thyme-leaf Sandwort. General. From Europe.
890. Arenaria stricta Mx. Rock Sandwort. Ottawa, Erie, Cuyahoga, Clark, Franklin.
891. Arenaria patula Mx. Pitcher's Sandwort. Montgomery County.

892. Moehringia lateriflora (L.) Fenzl. Bluntleaf Moeringia. Ottawa, Auglaize, Morrow, Perry, Franklin, Darke.

893. Holosteum umbellatum L. Jagged Chickweed. Hamilton County. From Europe.

894. Alsine aquatica (L.) Britt. Water Chickweed. Guernsey County. From Europe.

895. Alsine media L. Common Chickweed. General and abundant. From Europe.

896. Alsine pubera (Mx.) Britt. Great Chickweed. Southern Ohio as far north as Preble and Fairfield Counties.

897. Alsine longifolia (Muhl.) Britt. Longleaf Stichwort. General.

898. Alsine graminea (L.) Britt. Lesser Stichwort. Cuyahoga, Auglaize, Belmont. From Europe.

899. Cerastium vulgatum L. Common Mouse-ear Chickweed. General. From Europe.

900. Cerastium longipedunculatum Muhl. Nodding Chickweed. General.

901. Cerastium arvense L. Field Chickweed. Monroe, Trumbull, Ottawa, Sandusky, Miami.

901a. Cerastium arvense webbii Jennings. Cuyahoga County.

902. Cerastium velutinum Raf. Barren Chickweed. Erie, Monroe.

903. Spergula arvensis L. Corn Spurry. Lake County. From Europe.

904. Tissa rubra (L.) Britt. Sand Spurry. Lake County. From Europe.

Subfamily, CARYOPHYLLATAE.

905. Agrostemma githago L. Corn Cockle. General. From Europe.

906. Lychnis coronaria (L.) Desv. Mullen Pink. Lake, Cuyahoga, Portage, Fairfield. From Europe.

907. Lychnis viscaria L. Viscid Lychnis. Lake County. Escaped.

908. Lychnis alba Mill. White Lychnis. Lake, Wayne, Noble, Meigs. From Europe.

909. Lychnis dioica L. Red Lychnis. From Europe. (Erie County —Moseley Herbarium.)

910. Silene stellata (L.) Ait. Starry Campion. General.

911. Silene alba Muhl. White Campion. Butler, Clermont.

912. Silene latifolia (Mill.) Britt & Rend. Bladder Campion. Erie County. From Europe.

913. Silene virginica L. Fire Pink. General.
914. Silene rotundifolia Nutt. Roundleaf Catchfly. Hocking, Jackson.
915. Silene armeria L. Sweet William Catchfly. Monroe, Licking, Cuyahoga, Lake. From Europe.
916. Silene noctiflora L. Night-blooming Catchfly. Greene, Auglaize, Lucas, Sandusky, Erie, Cuyahoga, Lake, Belmont, Jefferson. From Europe.
917. Silene dichotoma Ehrh. Forked Catchfly. Noble County, (Ottawa County—Moseley Herbarium). From Europe.
918. Silene conica L. Striate Catchfly. Sandusky County. From Europe.
919. Silene regia Sims. Royal Catchfly. Clark, Madison.
920. Silene caroliniana Walt. Carolina Catchfly. Washington, Monroe, Jefferson.
921. Silene antirrhina L. Sleepy Catchfly. General.
922. Saponaria officinalis L. Bouncing-Bet. General. From Europe.
923. Vaccaria vaccaria (L.) Britt. Cowherb. Ashtabula, Lake. From Europe.
924. Dianthus prolifer L. Proliferous Pink. Cuyahoga County. From Europe.
925. Dianthus armeria L. Deptford Pink. Jefferson, Gallia, Licking. From Europe.
926. Dianthus deltoides L. Maiden Pink. Lake County. Escaped.
927. Dianthus barbatus L. Sweet William. Portage County. From Europe.

**Aizoaceae.** Carpetweed Family.

928. Mollugo verticillata L. Carpetweed. General. From the South.

**Portulacaceae.** Purslane Family.

929. Claytonia virginica L. Spring-beauty. General and abundant.
930. Limnia perfoliata (Donn.) Haw. Spanish-lettuce. No specimens. From the West.
931. Portulaca oleracea L. Purslane. Hamilton, Fayette, Auglaize, Holmes, Huron, Erie, Franklin. From the Southwest.
932. Portulaca grandiflora Hook. Garden Portulaca. Auglaize, Franklin. Escaped.

**Nyctaginaceae.** Four-o'clock Family.

933. Allionia nyctaginea Mx. Heartleaf Umbrella-wort. Hamilton, Montgomery, Greene, Champaign, Monroe, Erie. From the West.
934. Allionia hirsuta Pursh. Hairy Umbrella-wort. Ashtabula County. From the West.
935. Mirabilis jalapa L. Four-o'clock. Persistent in Franklin County.

**Phytolaccaceae.** Pokeweed Family.

936. Phytolacca americana L. Pokeweed. General and abundant.

Order, *Chenopodiales.*

**Corrigiolaceae.** Whitlow-wort Family.

937. Anychia polygonoides Raf. Forked Anychia. Southern part of state as far north as Franklin, Holmes, and Belmont Counties; also in Ottawa and Erie Counties.
938. Anychia canadensis (L.) B. S. P. Slender Anychia. General.
939. Scleranthus annuus L. Knawel. Lake County. From Europe.

**Amaranthaceae.** Amaranth Family.

940. Celosia cristata L. Cock's-comb. Franklin County. Persistent.
941. Amaranthus retroflexus L. Rough Pigweed. General and abundant. From tropical America.
942. Amaranthus hybridus L. Slender Pigweed. General. From tropical America.
943. Amaranthus spinosus L. Spiny Amaranth. Southern half of state. From tropical America.
944. Amaranthus graecizans L. Tumble-weed (Amaranth). Western half of state, from Hamilton to Franklin and Lake Counties.
945. Amaranthus blitoides Wats. Mat Amaranth. General. From the West.
946. Acnida tuberculata Moq. Tubercled Water-hemp. Rather general.
947. Acnida tamariscina (Nutt.) Wood. Western Water-hemp. Franklin, Clinton. From the West.
948. Iresine paniculata (L.) Ktz. Bloodleaf. No specimens.
949. Gomphrena globosa L. Globe-amaranth. Wood County. Escaped from gardens.

**Chenopodiaceae.** Goosefoot Family.

950. Chenopodium album L. Lamb's-quarter. General and abundant. From Europe.
951. Chenopodium glaucum L. Oakleaf Goosefoot. Summit, Erie, Ottawa, Lucas, Auglaize. From Europe.
952. Chenopodium leptophyllum (Moq.) Nutt. Narrowleaf Goosefoot. Lake, Lorain.
953. Chenopodium vulvaria L. Fetid Goosefoot. Lorain County. From Europe.
954. Chenopodium polyspermum L. Many-seeded Goosefoot. Lake County. From Europe.
955. Chenopodium boscianum Moq. Bosc's Goosefoot. Washington, Meigs, Ross, Franklin, Miami, Ottawa, Erie.
956. Chenopodium murale L. Nettle-leaf Goosefoot. Rather general. From Europe.
957. Chenopodium hybridum L. Maple-leaf Goosefoot. Rather general.
958. Chenopodium botrys L. Feather Geranium. Rather general. From Europe.
959. Chenopodium ambrosioides L. Mexican Tea. Rather general. From tropical America.
960. Blitum capitatum L. Strawberry Blite. Summit County.
961. Spinacia oleracea L. Common Spinach. Lorain County. Escaped from gardens.
962. Cycloloma atriplicifolium (Spreng.) Coult. Tumbleweed. Erie, Lake. From the West.
963. Kochia scoparia (L.) Roth. Mock-cypress. Morgan, Franklin, Cuyahoga. From Europe.
964. Atriplex hastata L. Halberd-leaf Orache. General.
965. Atriplex rosea L. Red Orache. Erie County. From Europe.
966. Salsola pestifer Nels. Russian-thistle. Williams, Lucas, Auglaize, Ottawa, Erie, Wayne, Cuyahoga, Lake, Portage. From Europe.

Order, *Polygonales.*

**Polygonaceae.** Buckwheat Family.

967. Rumex altissimus Wood. Tall Dock. Rather general.
968. Rumex verticillatus L. Swamp Dock. Rather general.
969. Rumex mexicanus Meisn. Willow-leaf Dock. Allen County.

970. Rumex patientia L. Patience Dock. From Europe. No specimens.

971. Rumex britannica L. Great Water Dock. Williams, Erie, Coshocton, Licking, Franklin, Hocking, Champaign.

972. Rumex crispus L. Curled Dock. Naturalized from Europe. General and abundant.

973. Rumex conglomeratus Murr. Clustered Dock. Lake County. From Europe.

974. Rumex obtusifolius L. Broadleaf Dock. Naturalized from Europe. General and abundant.

975. Rumex acetosella L. Sheep Sorrel. General and abundant. From Europe.

976. Pleuropterus zuccarinii Small. Japanese Knotweed. Cuyahoga County. From Japan.

977. Tiniaria convolvulus (L.) W. & M. Black Bindweed. General. Naturalized from Europe.

978. Tiniaria scandens (L.) Small. Climbing False Buckwheat. General.

979. Tiniaria dumetorum (L.) Opiz. Copse False Buckwheat. From Europe. (Erie, Ottawa—Moseley Herbarium.)

980. Tracaulon arifolium (L.) Raf. Halberd-leaf Tear-thumb. Northern part of state as far south as Auglaize and Belmont Counties.

981. Tracaulon sagittatum (L.) Small. Arrow-leaf Tear-thumb. General.

982. Fagopyrum fagopyrum (L.) Karst. Buckwheat. From Europe. General.

983. Persicaria amphibia (L.) S. F. Gr. Water Persicaria. Summit, Fairfield, Ottawa, Stark, Franklin, Clark.

984. Persicaria muhlenbergii (Wats.) Small. Swamp Persicaria. Northern half of state to Shelby and Perry Counties.

985. Persicaria lapathifolia (L.) S. F. Gray. Pale Persicaria. General. Naturalized from Europe.

986. Persicaria pennsylvanica (L.) Small. Pennsylvania Persicaria. General and abundant.

987. Persicaria careyi (Olney) Greene. Carey's Persicaria. Erie County.

988. Persicaria persicaria (L.) Small. Lady's-thumb. General and abundant. Naturalized from Europe.

989. Persicaria hydropiperoides (Mx.) Small. Mild Smartweed. General.
990. Persicaria hydropiper (L.) Opiz. Water Smartweed. General. From Europe.
991. Persicaria punctata (Ell.) Small. Dotted Smartweed. General.
992. Persicaria orientalis (L.) Spach. Prince's-feather. Lucas, Montgomery, Franklin, Hocking, Meigs, Scioto. Native of India.
993. Tovara virginiana (L.) Raf. Virginia Knotweed. General.
994. Polygonum aviculare L. Doorweed. General and abundant.
995. Polygonum buxiforme Small. Shore Knotweed. Wayne County.
996. Polygonum erectum L. Erect Knotweed. Lake, Richland, Franklin, Muskingum, Morgan, Hocking, Athens, Meigs, Warren, Clermont.
997. Polygonum ramosissimum Mx. Bushy Knotweed. Lake, Franklin. Waifs from the West.
998. Polygonum tenue Mx. Slender Knotweed. Erie County.

Order, *Piperales*.

**Saururaceae.** Lizard's-tail Family.

999. Saururus cernuus L. Lizard's-tail. General.

Subclass, CALYCIFLORAE.

Order, *Rosales*.

**Rosaceae.** Rose Family.

Subfamily, ROSATAE.

1000. Geum rivale L. Purple Avens. Champaign, Geauga.
1001. Geum canaadense Jacq. White Avens. General.
1002. Geum flavum (Port.) Bickn. Cream-colored Avens. No specimens.
1003. Geum virginianum L. Rough Avens. General.
1004. Geum strictum Ait. Yellow Avens. Eastern half of state; also in Preble County.
1005. Geum vernum (Raf.) T. & G. Spring Avens. General.
1006. Dasiphora fruticosa (L.) Rydb. Shrubby Cinquefoil. Rather general.
1007. Potentilla paradoxa Nutt. Bushy Cinquefoil. Erie County.
1008. Potentilla argentea L. Silvery Cinquefoil. Portage, Cuyahoga, Erie, Licking.

1009. Potentilla recta L. Upright Cinquefoil. Lake, Erie, Franklin, Hocking. From Europe.

1010. Potentilla monspeliensis L. Rough Cinquefoil. General.

1011. Potentilla canadensis L. Common Five-finger. General and abundant.

1012. Potentilla pumila Poir. Dwarf Five-finger. Lake, Monroe, Vinton.

1013. Potentilla reptans L. European Five-finger. Lake County. From Europe.

1014. Argentina anserina (L.) Rydb. Silverweed. Cuyahoga, Lorain, Erie, Ottawa, Lucas, Hamilton.

1015. Comarum palustre L. Purple Marshlocks. Ashtabula, Lorain, Portage, Summit, Ashland, Stark, Licking.

1016. Drymocallis agrimonioides (Pursh.) Rydb. Tall Cinquefoil. Erie, Cuyahoga, Lake.

1017. Waldsteinia fragarioides (Mx.) Tratt. Dry Strawberry. Ashtabula, Cuyahoga, Portage, Medina, Clark, Franklin, Greene.

1018. Fragaria americana (Port.) Britt. American Wood Strawberry. Rather general.

1019. Fragaria vesca L. European Wood Strawberry (white-fruited variety). Belmont, Hocking. From Europe.

1020. Fragaria virginiana Duch. Virginia Strawberry. General and abundant.

1021. Rubus frondosus Bigel. Leafy-flowered Blackberry. Lake, Columbiana, Coshocton, Hancock, Gallia.

1022. Rubus alleghaniensis Port. High Blackberry. General and abundant.

1023. Rubus procumbens Muhl. Common Dewberry. General.

1024. Rubus hispidus L. Hispid Dewberry. Ashtabula, Lake, Portage, Summit, Geauga, Cuyahoga, Lucas, Logan.

1025. Rubus occidentalis L. Black Raspberry. General and abundant.

1026. Rubus neglectus Peck. Purple Raspberry. Ashtabula, Stark, Defiance, Williams.

1027. Rubus strigosus Mx. Wild Red Raspberry. Summit, Erie, Clark.

1028. Rubus triflorus Richards. Dwarf Raspberry. Lake, Stark, Lucas, Wood, Sandusky, Wyandot, Champaign, Fairfield, Vinton, Brown.

1029. Rubus phoenicolasius Max. Wineberry. Lake County. Escaped from cultivation.

1030. Rubus odoratus L. Rose-flowered Raspberry. Lake, Cuyahoga, Ashtabula, Summit, Belmont, Jefferson, Monroe, Muskingum, Fairfield.

1031. Porteranthus trifoliatus (L.) Britt. Indian-physic. No specimens.

1032. Porteranthus stipulatus (Muhl.) Britt. American Ipecac. Southern Ohio to Clinton and Guernsey Counties.

1033. Schizonotus sorbifolius (L.) Lindl. Mountain-ash Spiraea. Lake Harrison. From Asia.

1034. Filipendula rubra (Hill.) Rob. Queen-of-the-prairie. Cuyahoga. Erie, Madison, Champaign, Holmes.

1035. Opulaster opulifolius (L.) Ktz. Ninebark. General.

1036. Spiraea alba DuRoi. Narrowleaf Spiraea. General.

1037. Spiraea tomentosa L. Steeple-bush. Eastern half of state west to Cuyahoga, Fairfield, and Jackson Counties; also in Lucas County.

1038. Aruncus aruncus (L.) Karst. Aruncus. Southeastern part of state to Columbiana, Licking, and Scioto Counties.

1039. Dalibarda repens L. Dalibarda. Ashtabula County.

1040. Rosa blanda Ait. Smooth Rose. Lake, Lorain, Erie, Williams, Mercer, Clinton, Clermont.

1041. Rosa carolina L. Swamp Rose. General and abundant.

1042. Rosa virginiana Mill. Virginia Rose. General and abundant.

1043. Rosa rubiginosa L. Swetbrier (Rose). General. From Europe.

1043. Rosa rubiginosa L. Sweetbrier (Rose). General. From Europe.

1044. Rosa gallica L. French Rose. Lake County. Escaped.

1046. Agrimonia parviflora Sol. Small-flowered Agrimony. General.

1047. Agrimonia gryposepala Wallr. Hairy Agrimony. General.

1048. Agrimonia rostellata Wallr. Woodland Agrimony. Rather general.

1049. Agrimonia striata Mx. Striate Agrimony. Clinton County.

1050. Agrimonia mollis (T. & G.) Britt. Soft Agrimony. Rather general.

1051. Sanguisorba canadensis L. American Burnet. Lake, Cuyahoga, Stark, Miami, Champaign, Clark, Franklin.

1052. Poterium sanguisorba L. Garden Burnet. Lake County. From Europe.

Subfamily, MALATAE.

1053. Sorbus scopulina Greene. Western Mountain-ash. Ashtabula, Ottawa.

1053.1. Sorbus aucuparia L. European Mountain-ash. Lake, Crawford, Escaped.

1054. Pyrus communis L. Pear. Ashtabula, Cuyahog, Summit, Preble, Franklin, Brown. From Europe.

1055. Malus glaucescens Rehd. American Crab-apple. General.

1056. Malus coronaria (L.) Mill. Narrow-leaf Crab-apple. Rather general.

1057. Malus malus (L.) Britt. Common Apple. General. From Europe.

1058. Aronia arbutifolia (L.) Ell. Red Chokeberry. Ashtabula, Geauga, Stark, Licking, Wood.

1059. Aronia atropurpurea Britt. Purple Chokeberry. Licking County.

1060. Aronia melanocarpa (Mx.) Britt. Black Chokeberry. Rather general.

1061. Amelanchier canadensis (L.) Med. Common Juneberry. General.

1062. Amelanchier sanguinea (Pursh.) DC. Roundleaf Juneberry. Highland, Franklin, Erie, Lorain.

1063. Crataegus crus-galli L. Cockspur Hawthorn. General.

1064. Crataegus cuneiformis (Marsh.) Eggl. Marshall's Hawthorn. Rather general.

1065. Crataegus punctata Jacq. Dotted Hawthorn. General.

1066. Crataegus margaretta Ashe. Margaret Hawthorn. From Adams, Franklin, and Lucas Counties westward.

1067. Crataegus succulenta Schrad. Long-spined Hawthorn. Gen-general.

1068. Crataegus calpodendron (Ehrh.) Medic. Pear Hawthorn. General.

1069. Crataegus brainerdi Sarg. Brainerd's Hawthorn. Lucas, Richland.

1070. Crataegus chrysocarpa Ashe. Roundleaf Hawthorn. Williams County.

1071. Crataegus straminea Beadle. Allegheny Hawthorn. Knox, Franklin, Hocking.

1072. Crataegus boyntoni Beadle. Boynton's Hawthorn. Adams, Morgan, Noble, Guernsey, Tuscarawas.

1073. Crataegus macrosperma Ashe. Large-seeded Hawthorn. General.

1074. Crataegus leiophylla Sarg. Maine's Hawthorn. Jefferson County.

1075. Crataegus beata Sarg. Dunbar's Hawthorn. Lucas, Brown.

1076. Crataegus pruinosa (Wendl.) Koch. Pruinose Hawthorn. General.

1077. Crataegus pringlei Sarg. Pringle's Hawthorn. Williams County.

1078. Crataegus coccinea L. Scarlet Hawthorn. General, but no specimens from the northern counties.

1079. Crataegus albicans Ashe. Tatnall's Hawthorn. Brown, Ross, Jefferson, Ashtabula, Lake, Lucas.

1080. Crataegus mollis (T. & G.) Scheele. Downy Hawthorn. General.

1081. Crataegus monogyna Jacq. May Hawthorn. Williams, Lake, Cuyahoga, Medina, Franklin. From Europe.

1082. Crataegus phaenopyrum (L. f.) Medic. Washington Hawthorn. Jefferson County.

1083. Cotoneaster pyracantha (L.) Spach. Fire-thorn. Franklin County. From Europe.

Subfamily, AMYGDALATAE.

1084. Prunus virginiana L. Black Cherry. (Padus). General and abundant.

1085. Prunus nana DuRoi. Choke Cherry. (Padus). Rather general.

1086. Prunus mahaleb L. Mahaleb Cherry. Lake, Franklin. From Europe.

1087. Prunus pennsylvanica L. f. Red Cherry. Cuyahoga County.

1088. Prunus avium L. Sweet Cherry. Ashtabula, Cuyahoga, Erie, Ottawa, Summit, Ross. From Europe.

1089. Prunus cerasus L. Sour Cherry. Cuyahoga, Summit, Jefferson, Gallia, Clinton. From Europe.

1090. Prunus cuneata Raf. Appalachian Cherry. No specimens.

1091. Prunus pumila L. Sand Cherry. Erie County.

1092. Prunus americana Marsh. Wild Plum. General and abundant.

1093. Amygdalus persica L. Peach. Rather general. Native of Asia.

**Fabaceae.** Bean Family.

Subfamily, MIMOSATAE.

1094. Acuan illinoensis (Mx.) Ktz. Illinois Acuan. Hamilton, Clermont, Ashtabula.

Subfamily, CASSIATAE.

1095. Cersis canadensis L. Redbud. Rather general, but no specimen from the northeastern counties except Carroll.

1096. Cassia marylandica L. Wild Senna. General.

1097. Cassia medsgeri Shaf. Medsger's Senna. Stark, Washington, Monroe, Franklin, Ottawa.

1098. Chamaecrista nictitans (L.) Moench. Sensitive-pea. Adams, Butler, Gallia, Scioto, Jackson, Hocking, Fairfield, Licking, Stark.

1099. Chamaecrista fasciculata (Mx.) Greene. Large-flowered Sensitive-pea. Rather general in western half of state; also in Lake County.

1100. Gleditsia triacanthos L. Honey-locust. General.

1101. Gymnocladus dioica (L.) Koch. Coffee-bean. General.

Subfamily, FABATAE.

1102. Baptisia australis (L.) R. Br. Blue Wild-indigo. Hamilton, Meigs, Monroe, Lake.

1103. Baptisia tinctoria (L.) R. Br. Yellow Wild-indigo. Trumbull, Lake, Portage, Cuyahoga, Erie, Lucas, Wood.

1104. Baptisia leucantha T. & G. Large White Wild-indigo. Franklin, Crawford, Erie, Defiance.

1105. Crotalaria sagittalis L. Rattlebox. Franklin County. A waif.

1106. Lupinus perennis L. Wild Lupine. Portage, Erie, Sandusky, Wood, Fulton.

1107. Medicago sativa L. Alfalfa. Rather general. From Europe.

1108. Medicago lupulina L. Hop Medic. General. From Europe.

1109. Medicago hispida Gaertn. Toothed Medic. Lake County. From Europe.

1110. Melilotus alba Desv. White Sweet-clover. General and abundant. From Europe.

1111. Melilotus officinalis (L.) Lam. Yellow Sweet-clover. Rather general. From Europe.

1112. Trifolium agrarium L. Yellow Hop Clover. Ashtabula, Lake, Cuyahoga, Knox, Clermont, From Europe.

1113. Trifolium procumbens L. Low Hop Clover. Lake, Cuyahoga, Ottawa, Franklin, Montgomery, Gallia. From Europe.

1114. Trifolium dubium Sibth. Least Hop Clover. Rather general. From Europe.

1115. Trifolium incarnatum L. Crimson Clover. Rather general. From Europe.

1116. Trifolium arvense L. Rabbit-foot Clover. Warren, Stark, Cuyahoga, Lake. From Europe.

1117. Trifolium pratense L. Red Clover. General and abundant. Naturalized from Europe.

1118. Trifolium reflexum L. Buffalo Clover. No specimens.

1119. Trifolium stolniferum Muhl. Running Buffalo Clover. Hamilton, Clermont, Butler, Clinton, Clark, Franklin.

1120. Trifolium hybridum L. Alsike Clover. General. Introduced from Europe.

1121. Trifolium repens L. White Clover. General and abuntdant. Naturalized from Europe.

1122. Lotus corniculatus L. Bird's-foot Trefoil. Lake County. From Europe.

1123. Hosackia americana (Nutt.) Piper. Prarie Bird's-foot. Trefoil. Franklin county. A waif from the west.

1124. Psoralea stipulata T & G. Large-stipuled Psoralea. No specimen.

1125. Psoralea peduncultata (Mill.) Vail. Long-peduncled Psoralea. Erie, Scioto, Lawrence.

1126. Psoralea onobrychis Nutt. Sainfoin Psoralea. In the southwestern fourth of the state.

1127. Amorpha fruticosa L. False Indigo. Lucas County.

1128. Petalostemum purpureum (Vent.) Rydb. Violet Prairie-clover. A waif in Franklin County.

1129. Cracca virginiana I. Goat's-rue. Fulton, Lucas, Erie, Portage, Fairfield, Hocking, Washington, Jackson, Lawrence, Adams, Hamilton.

1130. Robinia pseudoacacia L. Common Locust. General.

1131. Robinia viscosa Vent. Clammy Locust. Ashtabula, Lake, Cuyahoga, Fairfield.

1132. Astragalus carolinianus L. Carolina Milk-vetch. Rather general.

1133. Phaca neglecta T. & G. Cooper's Milk-vetch. Ashtabula, Cuyahoga, Hamilton.

1134. Coronilla varia L. Coronilla. Lake, Brown. From Europe.

1135. Stylosanthes biflora (L.) B. S. P. Pencil-flower. Adams, Scioto, Lawrence, Gallia, Jackson, Hocking.

1136. Meibomia nudiflora (L.) Ktz. Naked-flowered Tick-trefoil. General.

1137. Meibomia grandiflora (Walt.) Ktz. Pointed-leaf Tick-trefoil. General.

1138. Meibomia pauciflora (Nutt.) Ktz. Few-flowered Tick-trefoil. Clermont, Clinton, Auglaize.

1139. Meibomia michauxii Vail. Prostrate Tick-trefoil. Rather general.

1140. Meibomia sessilifolia Torr.) Ktz. Sessile-leaf. Tick-trefoil. Erie, Wood.

1141. Meibomia canescens (L.) Ktz. Hoary Tick-trefoil. General.

1142. Meibomia bracteosa (Mx.) Ktz. Large-bracted Tick-trefoil. Rather general.

1143. Meibomia paniculata (L.) Ktz. Panicled Tick-trefoil. General.

1144. Meibomia viridiflora (L.) Ktz. Velvet-leaf Tick-trefoil. Gallia, Hocking, Cuyahoga.

1145. Meibomia dillenii (Darl.) Ktz. Dillen's Tick-trefoil. General.

1146. Meibomia illinoensis (Gr.) Ktz. Illinois Tick-trefoil. Erie, Ottawa,

1147. Meibomia canadensis (L.) Ktz. Canadian Tick-trefoil. Montgomery, Clark, Auglaize, Fulton, Wood, Erie, Cuyahoga.

1148. Meibomia rigida (Ell.) Ktz. Rigid Tick-trefoil. Paulding, Fairfield.

1149. Meibomia marylandica (L.) Ktz. Maryland Tick-trefoil. Hocking, Fairfield.

1150. Meibomia obtusa (Muhl.) Vail. Ciliate Tick-trefoil. Summit, Erie, Licking.

1151. Lespedeza repens (L.) Bart. Creeping Bush-clover. From Hocking, Franklin and Madison Counties southward; also in Cuyahoga County.

1152. Lespedeza procumbens Mx. Trailing Bush-clover. Fairfield, Wayne, Greene.

1153. Lespedeza nuttallii Darl. Nuttall's Bush-clover. (Moseley herbarium—Erie County.)

1154. Lespedeza violacea (L.) Pers. Violet Bush-clover. Rather general but no specimen from the northeastern counties.

1155. Lespedeza stuvei Nutt. Stuve's Bush-clover. No specimens. (Moseley Herbarium—Erie County).

1156. Lespedeza frutescens (L.) Britt. Wand-like Bush-clover. Rather general.

1157. Lespedeza virginica (L.) Britt. Slender Bush-clover. Scioto, Franklin, Erie.

1158. Lespedeza simulata Mack & Bush. Intermediate Bush-clover. No specimens.

1159. Lespedeza hirta (L.) Horn. Hairy Bush-clover. Rather general.

1160. Lespedeza capitata Mx. Round-headed Bush-clover. Defiance, Fulton, Wood, Ottawa, Erie, Cuyahoga, Franklin, Madison, Highland, Fairfield.

1161. Vicia cracca L. Cow Vetch. Cuyahoga, Lake, Columbiana, Wayne, Huron, Seneca.

1162. Vicia americana Muhl. American Vetch. Cuyahoga, Geauga, Erie, Ottawa, Lucas.

1163. Vicia caroliniana Walt. Carolina Vetch. In the northern and southern counties; also in Darke County.

1164. Vicia tetrasperma (L.) Moench. Slender Vetch. Lake County. From Europe.

1165. Vicia hirsuta (L.) Koch. Hairy Vetch. Lake, Sandusky, Knox. From Europe.

1166. Vicia sativa L. Common Vetch. Ottawa, Hamilton. From Europe.

1167. Vicia angustifolia L. Narrow-leaf Vetch. Lake County. From Europe.

1168. Lathyrus maritimus (L.) Bigel. Beach Pea. Ashtabula, Lake, Cuyahoga, Erie.

1169. Lathyrus venosus Muhl. Veiny Pea. Erie, Williams.

1170. Lathyrus palustris L. Marsh Pea. Lake, Cuyahoga, Summit, Wayne, Erie, Madison, Greene.

1171. Lathyrus myrtifolius Muhl. Myrtle-leaf Marsh Pea. Lake, Cuyahoga, Stark, Erie, Lucas, Defiance, Auglaize.

1172. Lathyrus ochroleucus Hook. Cream-colored Pea. Lake, Cuyahoga, Lorain, Ottawa.

1173. Lathyrus pratensis L. Meadow Pea. Lake County. From Europe.

1174. Dolichos lablab L. Hyacinth Bean. Franklin County. Escaped from gardens.

1175. Glycine apios L. Ground-nut. Rather general.

1176. Falcata comosa (L.) Ktz. Hog-peanut. General.

1177. Falcata pitcheri (T. & G.) Ktz. Pitcher's Hog-peanut. Rather general.

1178. Phaseolus polystachyus (L.) B. S. P. Wild Bean. No specimens.

1179. Phaseolus nanus L. Bush Bean. Auglaize County. Introduced.

1180. Strophostyles helvola (L.) Britt. Trailing Wild Bean. In the lake shore counties and from Hocking County southward; also in Tuscarawas County.

Order, *Saxifragales.*

**Crassulaceae.** Orpine Family.

Subfamily, CRASSULATAE.

1181. Sedum triphyllum (Haw.) S. F. Gr. Live-forever. Williams, Erie, Knox, Coshocton, Franklin. From Europe.

1182. Sedum telephioides Mx. American Orpine. Adams County.

1183. Sedum acre L. Wall-pepper. Franklin, Ottawa. From Europe.

1184. Sedum ternatum Mx. Wild Stonecrop. General.

Subfamily, PENTHORATAE.

1185. Penthorum sedoides L. Ditch Stonecrop. General and abundant.

**Podostemaceae.** River-weed Family.

1186. Podostemon ceratophyllum Mx. River-weed. No specimens.

**Saxifragaceae.** Saxifrage Family.

1187. Micranthes pennsylvanica (L.) Haw. Pennsylvania Saxifrage. Fulton, Auglaize, Clark, Richland, Lorain, Geauga, Stark.

1188. Micranthes virginiensis (Mx.) Small. Early Saxifrage. Eastern half of state to Cuyahoga and Ross Counties; also in Hamilton County.

1189. Sullivantia sullivantii (T. & G.) Britt. Sullivantia. Adams, Highland, Hocking.

1190. Tiarella cordifolia L. False Mitrewort. Cuyahoga, Lorain, Huron, Belmont, Gallia, Highland.

1191. Heuchera americana L. Alum-root. General and abundant.

1192. Mitella diphylla L. Two-leaf Bishop's-cap. General.

1193. Chrysosplenium americanum Schw. Golden Saxifrage. Cuyahoga, Belmont, Stark, Fairfield.

Order, *Thymeleales.*

**Lythraceae.** Loosestrife Family.

1194. Ammannia coccinea Rottb. Longleaf Ammannia. Erie County.
1195. Rotala ramosior (L.) Koehne. Rotala. Hamilton, Licking, Ottawa.
1196. Decodon verticillatus (L.) Ell. Swamp Loosestrife. Rather general.
1197. Lythrum alatum Pursh. Wing-angled Loosestrife. Rather general; no specimens from the southeast.
1198. Lythrum salicaria L. Spiked Loosestrife. Lake, Cuyahoga. From Europe.
1199. Parsonsia petiolata (L.) Rusby. Blue Waxweed. Southern half of state; also in Cuyahoga and Wayne Counties.

**Melastomaceae.** Meadow-beauty Family.

1200. Rhexia virginica L. Virginia Meadow-beauty. Erie County.

**Thymeleaceae.** Mezereum Family.

1201. Dirca palustris L. Leatherwood. Rather general.

**Elaeagnaceae.** Oleaster Family.

1202. Lepargyraea canadensis (L.) Greene. Canadian Buffalo-berry. Erie, Cuyahoga, Lake.

Order, *Celastrales.*

**Rhamnaceae.** Buckthorn Family.

1203. Rhamnus cathartica L. Common Buckthorn. Greene County. From Europe.
1204. Rhamnus lanceolata Pursh. Lanceleaf Buckthorn. From Delaware County southward and southwestward.
1205. Rhamnus alnifolia L'Her. Alderleaf Buckthorn. Lake, Cuyahoga, Stark, Champaign.
1206. Rhamnus caroliniana Walt. Carolina Buckthorn. Adams County.
1207. Ceanothus americanus L. Common New Jersey Tea. General in eastern part of the state westward to Ottawa, Clark, Greene, and Adams Counties.
1208. Ceanothus ovatus Desf. Smaller New Jersey Tea. Erie, Ottawa, Crawford.

**Vitaceae.** Grape Family.

1209. Vitis labrusca L. Northern Fox Grape. Rather general.
1210. Vitis aestivalis Mx. Summer Grape. General.
1211. Vitis bicolor LeC. Winter Grape. General in eastern part of state to Knox and Adams Counties; also in Williams County.
1212. Vitis vulpina L. Riverside Grape. General and abundant.
1213. Vitis cordifolia Mx. Frost Grape. Rather general.
1214. Ampelopsis cordata Mx. Heartleaf Ampelopsis. Scioto County.
1215. Parthenocissus quinquefolia (L.) Planch. Virginia Creeper. General and abundant.

**Celastraceae.** Stafftree Family.

1216. Euonymus atropurpureus Jacq. Wahoo. General and abundant.
1217. Euonymus europaeus L. Spindletree. Lake County. Escaped.
1218. Euonymus obovatus Nutt. Running Strawberry-bush. Rather general.
1219. Euonymus americanus L. American Strawberry-bush. No specimens.
1220. Celastrus scandens L. Waxwork. General.

**Ilicaceae.** Holly Family.

1221. Nemopanthus mucronata (L.) Trel. Mountain Holly. Stark, Summit, Defiance, Williams.
1222. Ilex verticillata (L.) Gr. Winterberry. General.
1223. Ilex opaca Ait. American Holly. Lawrence County.

**Staphyleaceae.** Bladdernut Family.

1224. Staphylea trifolia L. American Bladdernut. General and abundant.

Order, *Sapindales.*

**Sapindaceae.** Soap-berry Family.

1225. Cardiospermum halicacabum L. Balloon-vine. No specimens. Native of tropical America.

**Aesculaceae.** Buckeye Family.

1226. Aesculus hippocastanum L. No specimens. Native of Asia.

1227. Aesculus glabra Willd. Ohio Buckeye. General and abundant.
1228. Aesculus octandra Marsh. Yellow Buckeye. Southern part of the state, north to Monroe and Fairfield Counties.

**Aceraceae.** Maple Family.

1229. Acer spicatum Lam. Mountain Maple. From Lorain, Wayne, and Muskingum Counties eastward; also in Greene County.
1230. Acer saccharum Marsh. Sugar Maple. General and abundant.
1231. Acer nigrum Mx. Black Maple. General and abundant.
1232. Acer rubrum L. Red Maple. General.
1233. Acer saccharinum L. Silver Maple. General and abundant.
1234. Acer negundo L. Boxelder. General and abundant.

**Anacardiaceae.** Sumac Family.

1235. Rhus copallina L. Mountain Sumac. Rather general, but no specimens from the west central part of the state.
1236. Rhus hirta (L.) Sudw. Staghorn Sumac. Rather general.
1237. Rhus glabra L. Smooth Sumac. General and abundant.
1238. Schmaltzia crenata (Mill.) Greene. Fragrant Sumac. Western two-thirds of the state.
1239. Toxicodendron vernix (L.) Ktz. Poison Sumac. Geauga, Cuyahoga, Lorain, Wayne, Wyandot, Licking, Fairfield.
1240. Toxicodendron radicans (L.) Ktz. Poison Ivy. General and abundant.
1241. Cotinus cotinus (L.) Sarg. European Smoketree. Escaped in Jefferson County.

Subclass AMENTIFERAE.

Order, *Platanales.*

**Hamamelidaceae.** Witch-hazel Family.

Subfamily, HAMAMELIDATAE.

1242. Hamamelis virginiana L. Witch-hazel. General, but no specimens from the west central counties.

Subfamily, ALTINGIATAE.

1243. Liquidambar styraciflua L. Sweet-gum. Gallia, Lawrence, Scioto, Adams, Brown, Greene.

**Platanaceae.** Plane-tree Family.

1244. Platanus occidentalis L. Sycamore. General and abundant.

Order, *Urticales.*

**Ulmaceae.** Elm Family.

1245. Ulmus americana L. White Elm. General and abundant.
1246. Ulmus thomasi Sarg. Cork Elm. Cuyahoga, Lorain, Ottawa, Huron, Hancock, Hardin, Logan, Franklin, Lawrence, Greene.
1247. Ulmus fulva Mx. Slippery Elm. General and abundant.
1248. Celtis occidentalis L. Common Hackberry. (Including C. crassifolia—young plants and vigorous shoots.) General and abundant, but no specimens from the extreme northeastern counties.

**Moraceae.** Mulberry Family.

Subfamily, MORATAE.

1249. Morus rubra L. Red Mulberry. General.
1250. Morus alba L. White Mulberry. Introduced. Erie, Lorain, Medina, Summit, Carroll, Montgomery, Clermont, Lawrence.
1251. Toxylon pomiferum Raf. Osage-orange. From the Southwest. General except in the northeastern counties.

Subfamily, CANNABINATAE.

1252. Humulus lupulus L. Hop. General. Introduced.
1253. Humulus japonicus S. & Z. Japanese Hop. A waif in Lucas County.
1254. Cannabis sativa L. Hemp. Clermont, Greene, Franklin, Belmont, Coshocton, Holmes, Lucas. Introduced.

**Urticaceae.** Nettle Family.

1255. Urtica dioica L. Stinging Nettle. From Europe. Jefferson, Cuyahoga, Lorain.
1256. Urtica gracilis L. Slender Nettle. General.
1257. Urtica urens L. Small Nettle. From Europe. Lake County.
1258. Urticastrum divaricatum (L.) Ktz. Wood Nettle. General.
1259. Pilea pumila (L.) Gr. Clearweed. General.
1260. Boehmeria cylindrica (L.) Sw. False Nettle. General.
1261. Parietaria pennsylvanica Muhl. Pellitory. General.

Order, *Fagales.*

**Fagaceae.** Beech Family.

1262. Fagus grandifolia Ehrh. American Beech. General and abundant.

1263. Castanea dentata (Marsh.) Borkh. Chestnut. Eastern half of state to Lorain, Franklin, and Adams Counties.

1264. Quercus prinus L. Rock Chestnut Oak. Eastern and southern parts of the state to Cuyahoga, Fairfield, and Clermont Counties.

1265. Quercus muhlenbergii Engelm. Chestnut Oak. General, but no specimens east of Erie nor north of Muskingum and Monroe Counties.

1266. Quercus prinoides Willd. Scrub Chestnut Oak. Starke County.

1267. Quercus bicolor Willd. Swamp White Oak. General.

1268. Quercus alba L. White Oak. General and abundant.

1269. Quercus stellata Wang. Post Oak. From Madison and Morgan Counties southward.

1270. Quercus macrocarpa Mx. Bur Oak. General in the western half of the state to Erie, Franklin, and Fairfield Counties; also in Ashtabula and Belmont Counties.

1271. Quercus imbricaria Mx. Shingle Oak. General.

1271a. Quercus imbricaria X velutina. A hybrid in Hamilton, Licking, Harrison, Erie and Lucas Counties.

1272. Quercus marilandica Muench. Black-Jack (Oak). Adams; Lawrence.

1273. Quercus ilicifolia Wang. Bear Oak. No specimens.

1273.1. Quercus triloba Mx. Spanish Oak. Lawrence County.

1274. Quercus velutina Lam. Quercitron Oak. General.

1275. Quercus coccinea Wang. Scarlet Oak. Hamilton, Auglaize, Fairfield, Franklin, Richland.

1276. Quercus rubra L. Red Oak. General and abundant.

1277. Quercus palustris DuRoi. Pin Oak. General.

**Betulaceae.** Birch Family.

1278. Carpinus caroliniana Walt. Blue-beech. General and abundant.

1279. Ostyra virginiana (Mill.) Willd. Hop-hornbeam. General and abundant.

1280. Corylus americana Walt. Common Hazelnut. General.

1281. Betula lenta L. Sweet Birch. Fairfield, Hocking, Adams, Scioto.

1282. Betula lutea Mx. f. Yellow Birch. Ashtabula, Stark, Summit, Lake, Cuyahoga, Lorain, Wayne, Fairfield, Hocking.

1283. Betula nigra L. River Birch. From Fairfield and Perry Counties southward.

1284. Betula alba L. European White Birch. Escaped in Lake County.

1285. Betula pumila L. Low Birch. Summit, Stark, Wyandot, Champaign.

1286. Alnus incana (L.) Willd. Hoary Alder. Cuyahoga, Lake, Geauga.

1287. Alnus rugosa (DuRoi), Spreng. Smooth Alder. Eastern half of state, to Lorain, Fairfield and Scioto Counties.

**Juglandaceae.** Walnut Family.

1288. Hicoria cordiformis (Wang.) Britt. Bitternut (Hickory). General and abundant.

1289 Hicoria microcarpa (Nutt.) Britt. Small Pignut (Hickory). General.

1290 Hicoria glaba (Mill.) Britt. Pignut (Hickory.) Rather general, but no speicmens from the west central part.

1291. Hicoria alba (L.) Britt. Mockernut (Hickory). Rather general, but no specimens from the extreme eastern and extreme western counties.

1292. Hicoria laciniosa (Mx. f.) Sarg. Shellbark (Hickory). Huron, Wyandot, Licking, Franklin, Pickaway, Scioto, Clermont.

1293. Hicoria ovata (Mill.) Britt. Shagbark (Hickory). General and abundant.

1294. Juglans nigra L. Black Walnut. General and abundant.

1295. Juglans cinerea L. Butternut. General, but no specimens from the northeastern counties.

**Myricaceae.** Bayberry Family.

1296. Comptonia peregrina (L.) Coult. Comptonia. Lake, Erie, Portage, Lucas, Fulton, Wood, Knox.

Order, *Salicales.*

**Salicaceae.** Willow Family.

1297. Populus alba L. White Poplar. General. Introduced.

1298. Populus heterophyla L. Swamp Poplar. Lake, Huron, Richland, Williams, Auglaize, Shelby, Logan, Knox, Licking.

1299. Populus balsamifera L. Balsam Poplar. Huron, Ashtabula, Geauga, Carroll.

1299a. Populus balsamifera candicans (Ait.) Gr. Balm-of-Gilead. Preble, Clermont, Franklin, Hocking, Coshocton, Harrison, Jefferson, Lorain. Escaped from cultivation.

1300. Populus deltoides Marsh. Cottonwood. General.

1301. Populus italica Moench. Lombardy Poplar. Rather general; probably mostly planted. From Europe.

1302. Populus grandidentata Mx. Largetooth Aspen. General.

1303. Populus tremuloides Mx. American Aspen. General in the northern part of the state, south to Franklin and Hocking Counties, also in Adams County.

1304. Salix amygdaloides And. Peachleaf Willow. Northwestern half of state, from Ashtabula to Franklin Counties westward.

1305. Salix nigra Marsh. Black Willow. General and abundant.

1305a. Salix nigra X amygdaloides. Erie, Ashtabula.

1306. Salix lucida Muhl. Shining Willow. Northern part of state as far south as Logan and Knox Counties.

1307. Salix fragilis L. Crack Willow. General. From Europe.

1307a. Salix fragilis X alba. Franklin and Ottawa Counties.

1308. Salix pentandra L. Bayleaf Willow. Escaped in Franklin County.

1309. Salix alba L. White Willow. General. Native of Europe.

1309a. Salix alba X lucida. Ashtabula, Logan.

1309b. Salix alba X babylonica. Ashtabula County.

1310. Salix babylonica L. Weeping Willow. Native of Asia. Ashtabula, Wayne.

1310a. Salix babylonica X fragilis. Erie County.

1311. Salix interior Rowlee. Sandbar Willow. General and abundant.

1311a. Salix interior wheeleri Rowlee. Preble, Erie, Lake.

1312. Salix glaucophylla Bebb. Broadleaf Willow. Erie, Wyandot.

1313. Salix cordata Muhl. Heartleaf Willow. General.

1313a. Salix cordata X sericea. Ashtabula County.

1314. Salix adenophylla Hook. Furry Willow. Erie County.

1315. Salix candida Fl. Hoary Willow. Wyandot, Erie.

1316. Salix sericea Marsh. Silky Willow. General.

1317. Salix petiolaris Sm. Slender Willow. Erie, Wood, Lucas, Fulton.
1318. Salix bebbiana Sarg. Bebb's Willow. Northern counties from Ashtabula to Fulton County; also in Wyandot County.
1319. Salix discolor Muhl. Pussy Willow. General and abundant.
1320. Salix humilis Marsh. Prairie Willow. Lake, Wood, Lucas, Fulton, Fairfield, Hocking.
1320a. Salix humilis tristis (Ait.) Griggs. Athens Madison.
1321. Salix purpurea L. Purple Willow. Native of Europe. Rather general.
1322. Salix pedicellaris Pursh. Bog Willow. Williams, Portage, Wayne, Licking, Perry.

Subclass, MYRTIFLORAE.

Order, *Cactales.*

**Cactaceae.** Cactus Family.

1323. Opuntia humifusa Raf. Western Prickly-pair. Erie, Scioto.

Order, *Myrtales.*

**Hydrangeaceae.** Hydrangea Family.

Subfamily, PHILADELPHATAE.

1324. Philadelphus coronarius L. Garden Mock-orange. Erie, Auglaize, Belmont, Jefferson, Monroe. From Europe.

Subfamily, HYDRANGEATAE.

1325. Hydrangea arborescens L. Wild Hydrangea. Southern half of state to Champaign and Mahoning Counties.

**Grossulariaceae.** Gooseberry Family.

1326. Ribes lacustre (Pers.) Poir. Swamp Currant. (Erie County—Moseley Herbarium.)
1327. Ribes vulgare Lam. Red Currant. Fulton, Lorain, Cuyahoga, Ashtabula. Native of Europe.
1328. Ribes americanum Mill. Wild Black Currant. General.
1329. Ribes odoratum Wendl. Buffalo Currant. Belmont, Hocking, Franklin, Auglaize, Richland, Lake. From the west.
1330. Grossularia cynosbati (L.) Mill. Wild Gooseberry. General.
1331. Grossularia oxyacanthoides (L.) Mill. Northern Gooseberry. Stark, Wayne.

1332. Grossularia hirtella (Mx.) Spach. Low Gooseberry. Geauga, Summit, Champaign,

1333. Grossularia reclinata (L.) Mill. Garden Gooseberry. Lawrence, Franklin. From Europe.

**Onagraceae.** Evening-primrose Family.

1334. Ludwigia polycarpa S. & P. Many-fruited Ludwigia. Cuyahoga, Lucas, Auglaize, Hocking.

1335. Ludwigia alternifolia L. Seed-box. Rather general.

1336. Isnardia palustris L. Marsh Purslane. General.

1337. Chamaenerion angustifolium (L.) Scop. Fire-weed. Northern fourth of the state.

1338. Epilobium lineare Muhl. Linear-leaf. Willow-herb. Portage. Erie, Ottawa, Clark.

1339. Epilobium strictum Muhl. Downy Willow-herb. Licking County.

1340. Epilobium coloratum Muhl. Purple Willow-herb. General.

1341. Epilobium adenocaulon Haussk. Northern Willow-herb. Northern Ohio, south to Franklin and Madison Counties.

1342. Oenothera biennis L. Common Evening-primrose. General.

1343. Oenothera oakesiana Robb. Oakes' Evening-primrose. (Erie County—Moseley Herbarium.)

1344. Raimannia laciniata (Hill.) Rose. Cutleaf Evening-primrose. Cuyahoga County.

1345. Kneiffia pratensis Small. Meadow Sundrops. No specimens.

1346. Kneiffia pumila (L.) Spach. Small Sundrops. Eastern part of Ohio as far west as Cuyahoga and Hocking Counties.

1347. Kneiffia fruticosa (L.) Raim. Common Sundrops. Rather general, but no specimens from the western part of the state.

1348. Hartmannia speciosa (Nutt.) Small. White Evening-primrose. A waif in Franklin County.

1349. Lavauxia triloba (Nutt.) Spach. Three-lobed Evening-primrose. From two localities in Montgomery County.

1350. Gaura biennis L. Biennial Gaura. Rather general.

1351. Circaea lutetiana L. Common Enchanter's-nightshade. General and abundant.

1352. Circaea intermedia Ehrh. Intermediate Enchanter's-nightshade. No specimens.

1353. Circaea alpina L. Small Enchanter's-nightshade. Ashtabula, Cuyahoga, Lorain, Summit, Crawford, Clark, Hocking.

**Haloragidaceae.** Water-milfoil Family.

1354. Myriophyllum spicatum L. Spiked Water-milfoil. Rather general.

1355. Myriophyllum verticillatum L. Whorled Water-milfoil. Erie County.

1356. Myriophyllum heterophyllum Mx. Variant-leaf Water-milfoil. No specimens.

1357. Proserpinaca palustris L. Mermaid-weed. Ashtabula, Cuyahoga, Portage, Wayne, Erie, Wyandot.

Order, *Loasales.*

**Cucurbitaceae.** Gourd Family.

1358. Cucurbita pepo L. Pumpkin. Erie, Wood, Spontaneous.

1359. Cucurbita maxima Duchesne. Squash. Brown County. Spontaneous.

1360. Citrullus citrullus (L.) Karst. Watermelon. Athens, Ottawa, Spontaneous.

1361. Cucumis sativus L. Cucumber. No specimens. Sometimes spontaneous.

1362. Cucumis melo L. Muskmelon. Madison, Franklin. Spontaneous.

1363. Micrampelis lobata (Mx.) Greene. Wild Balsam-apple. Rather general.

1364. Sicyos augulatus L. Star Cucumber. Rather general.

Order, *Aristolochiales.*

**Aristolochiaceae.** Birthwort Family.

1365. Asarum canadense L. Canadian Wild-ginger. General.

1366. Asarum acuminatum (Ashe.) Bicken. Long-tipped Wild-ginger. Rather general.

1367. Asarum reflexum Bicken. Short-lobed Wild-ginger. Rather general.

1368. Aristolochia serpentaria L. Virginia Snakeroot. Rather general.

Order, *Santalales.*

**Santalaceae.** Sandalwood Family.

1369. Comandra umbellata (L.) Nutt. Bastard Toad-flax. Rather general.

**Loranthaceae.** Mistletoe Family.

1370. Phoradendron flavescens (Pursh) Nutt. American Mistletoe. Southern counties, as far north as Ross and Athens.

Subclass, HETEROMERAE.

Order, *Primulales.*

**Primulaceae.** Primrose Family.

1371. Lysimachia vulgaris L. Common Yellow Loosestrife. Lake County. From Europe.

1372. Lysimachia quadrifolia L. Whorled Yellow Loosestrife. General in the eastern half of the state; also in Fulton and Adams Counties.

1373. Lysimachia terrestris (L.) B. S. P. Bulb-bearing Yellow Loosestrife. Northeast fourth of state; also in Lucas and Hardin Counties.

1374. Lysimachia nummularia L. Moneywort. General. Naturalized from Europe.

1375. Steironema ciliatum (L.) Raf. Fringed Yellow Loosestrife. General.

1376. Steironema lanceolatum (Walt.) Gr. Lanceleaf Yellow Loosestrife. Southwestern half of state.

1377. Steironema quadriflorum (Sims.) Hitch. Linear-leaf Yellow Loosestrife. Rather general.

1378. Naumburgia thyrsiflora (L.) Duby. Tufted Yellow Loosestrife. Rather general.

1379. Trientalis americana (Pers.) Pursh. Starflower. Cuyahoga, Portage, Summit, Champaign.

1380. Anagallis arvensis L. Scarlet Pimpernel. Lake, Fairfield, Logan, Montgomery, Greene, Scioto, Gallia. From Europe.

1381. Hottonia inflata Ell. Featherfoil. Ashtabula County.

1382. Samolus floribundus H. B. K. Water Pimpernel. Rather general.

1383. Dodecatheon meadia L. Shooting-star. Erie, Clark, Darke, Hocking, Hamilton, Clermont.

**Plumbaginaceae.** Leadwort Family.

1384. Ceratostigma plumbaginoides Bunge. Ceratostigma. A waif in Lake County.

Order, *Ericales.*

**Pyrolaceae.** Wintergreen Family.

1385. Pyrola americana Sw. Roundleaf Wintergreen. Defiance, Lucas, Lake, Wayne, Stark, Trumbull, Fairfield, Hocking.

1386. Pyrola elliptica Nutt. Shinleaf Wintergreen. Rather general, except in the southern part of Ohio.

1387. Pyrola secunda L. One-sided Wintergreen. Cuyahoga, Geauga, Summit, Portage.

1388. Chimaphila unbellata (L.) Nutt. Pipsissewa, Lucas, Cuyahoga, Portage.

1389. Chimaphila maculata (L.) Pursh. Spotted Pipsissewa. Rather general in eastern half of state.

**Monotropaceae.** Indian-pipe Family.

1390. Monotropa uniflora L. Indian-pipe. General.

1391. Hypopitys americana (DC.) Small. Smooth Pinesap. Fairfield, Hocking.

1392. Hypopitys lanuginosa (Mx ) Nutt. Hairy Pinesap. Lake, Cuyahoga, Columbiana, Wayne.

**Ericaceae.** Heath Family.

1393. Ledum groenlandicum Oedr. Labrador Tea. Portage County.

1394. Azalea nudiflora L. Pink Azalea. Portage, Geauga, Lawrence.

1395. Azalea lutea L. Flame Azalea. Fairfield County.

1396. Azalea viscosa L. Swamp Azalea. Ashtabula County.

1397. Rhododendron maximum L. Great Rhododendron. Fairfield, Hocking.

1398. Kalmia latifolia L. Mountain Kalmia. Columbiana, Jefferson, Licking, Fairfield, Hocking, Jackson, Lawrence, Scioto.

1399. Chamaedaphne calyculata (L.) Moench. Leather-leaf. Geauga, Wayne, Stark, Williams, Defiance.

1400. Andromeda polifolia L. Wild Rosemary. Geauga, Wayne, Stark.

1401. Oxydendrum arboreum (L.) DC. Sorrel-tree. Adams, Fairfield, Hocking, Vinton, Jackson, Morgan, Meigs, Lawrence.

1402. Epigaea repens L. Trailing Arbutus. Cuyahoga, Geauga, Medina, Columbiana, Knox, Licking, Fairfield, Hocking, Jackson, Gallia, Lawrence.

1403. Gaultheria procumbens L. Creeping Wintergreen. Lucas, Cuyahoga, Wayne, Stark, Columbiana, Fairfield, Hocking, Jackson, Lawrence.

1404. Uva-ursi uva-ursi (L.) Britt. Bearberry. Erie County.

**Vacciniaceae.** Huckleberry Family.

1405. Polycodium stamineum (L.) Greene. Deerberry. Rather general in the eastern half of the state.

1406. Vaccinium corymbosum L. Tall Blueberry. Eastern half of state; also in Williams County.

1407. Vaccinium canadense Kalm. Canada Blueberry. Lucas, Stark.

1408. Vaccinium angustifolium Ait. Dwarf Blueberry. Rather general in the eastern two-thirds of the state.

1409. Vaccinium vacillans Kalm. Low Blueberry. Eastern half of state; also in Fulton, Lucas and Ottawa Counties.

1410. Vaccinium atrococcum (Gr.) Heller. Dark Blueberry. Williams County.

1411. Chiogenes hispidula (L.) T. & G. Creeping Snowberry. Summit, Stark.

1412. Oxycoccus macrocarpus (Ait.) Pursh. Large Cranberry. Williams, Defiance, Geauga, Ashland, Wayne, Richland, Licking.

1413. Gaylussacia frondosa (L.) T. & G. Blue Huckleberry. No specimen.

1414. Gaylussacia baccata (Wang.) Koch. Black Huckleberry. General.

Order, *Ebenales.*

**Ebenaceae.** Ebony Family.

1415. Diospyros virginiana L. Persimmon. Southern half of the state; also in Lucas County.

Subclass, TUBIFLORAE.

Order, *Polemoniales.*

**Polemoniaceae.** Phlox Family.

1416. Phlox paniculata L. Garden Phlox. General.
1417. Phlox maculata L. Spotted Phlox. Rather general.
1418. Phlox ovata L. Mountain Phlox. Fulton County.
1419. Phlox glaberrima L. Smooth Phlox. No specimens.
1420. Phlox pilosa L. Downy Phlox. Northern part of the state, as far south as Franklin County.
1421. Phlox divaricata L. Wild Blue Phlox. General and abundant.
1422. Phlox stolonifera Sims. Creeping Phlox. Hocking County.
1423. Pholox subulata L. Ground Phlox. General.
1424. Gilia rubra (L.) Heller. Standing-cypress. Escaped in Erie and Lake Counties.
1425. Polemonium reptans L. Greek Valerian. General and abundant.

**Convolvulaceae.** Morning-glory Family.

1426. Ipomoea purpurea (L.) Lam. Common Morning-glory. General. From tropical America.
1427. Ipomoea hederacea Jacq. Ivyleaf Morning-glory. Southwestern Ohio, from Gallia to Auglaize County; also in Lake County. From tropical America.
1428. Ipomoea lacunosa L. Small-flowered White Morning-glory. Hamilton, Clermont, Gallia.
1429. Ipomoea pandurata (L.) Meyer. Wild Potato-vine. General.
1430. Quamoclit coccinea (L.) Moench. Small Red Morning-glory. No specimens. From tropical America.
1431. Convolvulus arvensis L. Small Bindweed. General. Naturalized from Europe.
1342. Convolvulus spithamaeus L. Upright Bindweed. Gallia, Clermont, Auglaize, Lucas, Portage.
1433. Convolvulus sepium L. Hedge Bindweed. General.
1434. Convolvulus japonicus Thunb. Japanese Bindweed. Fayette, Auglaize, Huron, Erie, Medina. Escaped.

**Cuscutaceae.** Dodder Family.

1435. Cuscuta epilinum Weihe. Flax Dodder. Wayne County. From Europe.

1436. Cuscuta epithymum Murr. Clover Dodder. Mercer County. From Europe.

1437. Cuscuta arvense Beyrich. Field Dodder. Vinton, Tuscarawas, Wayne, Erie.

1438. Cuscuta polygonorum Engel. Smartweed Dodder. Rather general.

1439. Cuscuta indecora Choicy. Pretty Dodder. Montgomery County.

1440. Cuscuta coryli Engel. Hazel Dodder. Rather general.

1441. Cuscuta cephalanthi Engel. Buttonbush Dodder. Ottawa. Franklin.

1442. Cuscuta gronovii Willd. Gronovius' Dodder. General.

1443. Cuscuta compacta Juss. Compact Dodder. No specimens.

1444. Cuscuta paradoxa Raf. Glomerate Dodder. No specimens. From the west.

**Hydrophyllaceae.** Water-leaf Family.

1445. Hydrophyllum virginianum L. Virginia Water-leaf. General.

1446. Hydrophyllum macrophyllum Nutt. Large Water-leaf. Western part of Ohio, as far east as Gallia, Fairfield, Licking, and Wyandot Counties.

1447. Hydrophyllum appendiculatum Mx. Appendaged Water-leaf. General.

1448. Hydrophyllum canadense L. Broadleaf Water-leaf. Cuyahoga, Wayne, Morrow, Hardin, Greene, Belmont.

1449. Phacelia dubia (L.) Small. Small-flowered Phacelia. Fairfield County.

1450. Phacelia bipinnatifida Mx. Loose-flowered Phacelia. Hamilton County.

1451. Phacelia purshii Buckl. Pursh's Phacelia. General.

Order, *Gentianales.*

**Loganiaceae.** Logania Family.

1452. Spigelia marilandica L. Indian-pink. Lake County.

**Oleaceae.** Olive Family.

1453. Syringa vugaris L. Common Lilac. Lake, Jefferson. Escaped.

1454. Ligustrum vulgare L. Privet. Rather general. From Europe.

1455. Chionanthus virginica L. Fringetree. Meigs, Gallia, Pike.

1456. Fraxinus nigra Marsh. Black Ash. General in the northern part of the state, south to Preble, Green, Franklin and Harrison Counties.

1457. Fraxinus quadrangulata Mx. Blue Ash. Erie, Ottawa, Hancock, Auglaize, Franklin, Licking, Montgomery, Highland, Ross, Brown, Adams.

1458. Fraxinus pennsylvanica Marsh. Red Ash. General.

1459. Fraxinus lanceolata Borck. Green Ash. General.

1460. Fraximus biltmoreana Beadle. Biltmore Ash. Erie, Hardin, Franklin, Montgomery, Morgan, Hamilton, Brown, Lawrence, Meigs.

1461. Fraxinus americana L. White Ash. General and abundant.

**Gentianaceae.** Gentian Family.

1462. Centaurium centaurium (L.) Wight. European Centaury. Lake County. From Europe.

1463. Sabbatia angularis (L.) Pursh. Square-stemmed Sabbatia. General.

1464. Gentiana quinquefolia L. Stiff Gentian. Montgomery, Ross., Franklin, Wayne, Summit, Clark, Fulton, Cuyahoga.

1465. Gentiana crinita Froel. Fringed Gentian. Cuyahoga, Erie, Fulton, Auglaize, Champaign, Clark, Madison, Franklin.

1466. Gentiana puberula Mx. Downy Gentian. (Dasystephana). Erie County.

1467. Gentiana saponaria L. Soapwort Gentian. (Dasystephana). Cuyahoga, Lucas.

1468. Gentiana andrewsii Griseb. Closed Gentian. (Dasystephana). General, but no specimens southeast of Hamilton, Fairfield, and Columbiana Counties.

1469. Gentiana flavida Gr. Yellowish Gentian. (Dasystephana). Lucas County.

1470. Gentiana villosa L. Striped Gentian. (Dasystephana). Gallia County.

1471. Frasera carolinensis Walt. American Columbo. From Madison County southward and westward; also in Summit, Geauga and Portage Counties.

1472. Obolaria virginica L. Pennywort. Lake, Cuyahoga, Fairfield, Gallia, Lawrence, Clermont, Hamilton.

1473. Bartonia virginica (L.) B. S. P. Yellow Bartonia. Licking, Lake.

**Menyanthaceae.** Buckbean Family.

1474. Menyanthes trifoliata L. Buckbean. Ashtabula, Wayne, Licking.

**Apocynaceae.** Dogbane Family.

1475. Vinca minor L. Periwinkle. Rather general. Native of Europe.
1476. Apocynum androsaemifolium L. Spreading Dogbane. General.
1477. Apocynum cannabinum L. Indian Hemp. General and abundant.
1478. Apocynum sibiricum Jacq. Clasping-leaf Dogbane. Erie, Ashtabula.
1479. Apocynum pubescens R. Br. Velvet Dogbane. Auglaize, Franklin, Harrison, Adams.

**Asclepiadaceae.** Milkweed Family.

1480. Acerates viridiflora (Raf.) Eat. Green Milkweed. Rather general.
1481. Acerates floridana (Lam.) Hitch. Florida Milkweed. Erie, Jackson, Gallia.
1482. Asclepias tuberosa L. Pleurisy-root. General.
1483. Asclepias decumbens L. Decumbent Pleurisy-root. No specimens.
1484. Asclepias purpurascens L. Purple Milkweed. Madison, Auglaize, Lucas, Summit, Portage, Stark, Carroll.
1485. Asclepias incarnata L. Swamp Milkweed. General and abundant.
1486. Asclepias pulchra Ehrh. Hairy Milkweed. Lorain County.
1487. Asclepias sullivantii Engel. Sullivant's Milkweed. Erie, Fairfield.
1488. Asclepias amplexicaulis Sm. Bluntleaf Milkweed. Erie, Fairfield.
1489. Asclepias exaltata (L.) Muhl. Tall Milkweed. General.
1490. Asclepias variegata L. White Milkweed. Summit, Hocking.
1491. Asclepias quadrifolia L. Fourleaf Milkweed. General.
1492. Asclepias syriaca L. Common Milkweed. General and abundant.
1493. Asclepias verticillata L. Whorled Milkweed. Lucas, Ottawa, Erie, Cuyahoga, Clark, Greene, Fairfield, Athens.

1494. Gonolobus laevis Mx. Sandvine. Southern Ohio, as far north as Montgomery, Ross, and Washington Counties.

1495. Cynanchum nigrum (L.) Pers. Black Swallow-wort. Cuyahoga, Lake. From Europe.

1496. Vincetoxicum obliquum (Jacq.) Britt. Large-flowered Vincetoxicum. Lawrence, Hamilton, Greene, Franklin.

Order, *Scrophulariales.*

**Solanaceae.** Potato Family.

1497. Petunia violacea Lindl. Common Petunia. Monroe, Franklin. From South America.

1498. Nicotiana tabacum L. Common Tobacco. Adams, Huron. Escaped from cultivation.

1499. Datura metel L. Entire-leaf Jimson-weed. Lake County. From tropical America.

1500. Datura stramonium L. Common Jimson-weed. General. Naturalized. From the tropics.

1501. Lycium halmifolium Mill. Matrimony-vine. Rather general. From Europe.

1502. Physalodes physalodes (L.) Britt. Apple-of-Peru. Gallia, Hamilton, Clinton, Montgomery, Clark, Champaign, Franklin, Licking. From Peru.

1503. Physalis lanceolata Mx. Prairie Ground-cherry. General.

1504. Physalis ixocarpa Brot. Mexican Ground-cherry. Franklin County. Spontaneous after cultivation.

1505. Physalis virginiana Mill. Virginia Ground-cherry. Cuyahoga County.

1506. Physalis alkekengi L. Chinese-lantern (Ground-cherry). Persistent after cultivation. Franklin, Lake.

1507. Physalis heterophylla Nees. Clammy Ground-cherry. General and abundant.

1508. Physalis pubescens L. Low Hairy Ground-cherry. Morgan, Shelby.

1509. Physalis pruinosa L. Tall Hairy Ground-cherry. Franklin County. Escaped from cultivation.

1510. Solanum elaeagnifolium Cav. Silver-leaf Nightshade. A waif in Lucas County.

1511. Solanum carolinense L. Horse-nettle. General.

1512. Solanum tuberosum L. Potato. Monroe, Hocking, Franklin, Tuscarawas, Erie, Ottawa. Persistent after cultivation.

1513. Solanum dulcamara L. Bittersweet. General as far south as Clark, Licking, and Jefferson Counties; also in Meigs County. Naturalized from Europe.

1514. Solanum nigrum L. Black Nightshade. General and abundant.

1515. Solanum rostratum Dun. Buffalo-bur. Franklin, Marion, Ottawa, Cuyahoga, Summit, Lake. From the West.

1516. Lycopersicon lycopersicon (L.) Karst. Tomato. Rather general as an escape.

**Scrophulariaceae.** Figwort Family.

1517. Verbascum blattaria L. Moth Mullen. General and abundant. Naturalized from Europe.

1518. Verbascum thapsus L. Common Mullen. General and abundant. Naturalized from Europe.

1519. Scrophularia leporella Bickn. Hare Figwort. Cuyahoga County.

1521. Chelone glabra L. Smooth Turtle-head. General.

1522. Pentstemon hirsutus (L.) Willd. Hairy Beard-tongue. General.

1523. Pentstemon pentstemon (L.) Britt. Smooth Beard-tongue. Rather general.

1524. Pentstemon digitalis (Sweet) Nutt. Foxglove Beard-tongue. Rather general.

1525. Pentstemon cobaea Nutt. Cobaea Beard-tongue. Lake County.

1526. Collinsia verna Nutt. Blue-eyed-Mary. General.

1527. Mimulus ringens L. Square-stemmed Monkey-flower. General.

1528. Mimulus alatus Soland. Sharp-winged Monkey-flower. Rather general.

1529. Conobea multifida (Mx.) Benth. Conobea. Hamilton, Greene, Madison, Ottawa.

1530. Gratiola virginiana L. Clammy Hedge-hyssop. General.

1531. Gratiola sphaerocarpa Ell. Round-fruited Hedge-hyssop. Erie County.

1532. Ilysanthes dubia (L.) Barnh. Long-stalked False Pimpernel. Rather general.

1533. Ilysanthes attenuata (Muhl.) Small. Short-stalked False Pimpernel. Cuyahoga, Lorain, Huron, Stark, Scioto.

1534. Synthysis bullii (Eat.) Heller. Bull's Synthyris. Montgomery County.

1535. Veronica anagallis-aquatica L. Water Speedwell. Butler, Champaign, Auglaize, Lucas, Erie.
1536. Veronica americana Schwein. American Speedwell. Rather general.
1537. Veronica scutellata L. Skullcap Speedwell. Franklin, Licking, Crawford, Perry, Lucas, Ottawa, Erie, Cuyahoga.
1538. Veronica officinalis L. Common Speedwell. General and abundant.
1539. Veronica chamaedris L. Bird's-eye Speedwell. Lake County. From Europe.
1540. Veronica teucrium L. Germander Speedwell. Medina County. From Europe.
1541. Veronica serpyllifolia L. Thyme-leaf Speedwell. General.
1542. Veronica peregrina L. Purslane Speedwell. General.
1543. Veronica arvensis L. Field Speedwell. General. From Europe.
1544. Veronica agrestis L. Garden Speedwell. Montgomery, Franklin. From Europe.
1545. Veronica tournefortii Gmel. Tournefort's Speedwell. Madison, Franklin, Jefferson, Lorain, Cuyahoga, Lake. From Europe.
1546. Veronica hederaefolia L. Ivyleaf Speedwell. (Erie County—Moseley Herbarium.) From Europe.
1547. Leptandra virginica (L.) Nutt. Culver's-root. General.
1548. Digitalis purpurea L. Purple Foxglove. Cuyahoga, Lake. From Europe.
1549. Digitalis lutea L. Yellow Foxglove. A waif in Cuyahoga County.
1550. Buchnera americana L. Blue-hearts. Fulton County.
1551. Afzelia macrophylla (Nutt.) Ktz. Mullen Foxglove. General in western Ohio, as far east as Huron, Noble, and Vinton Counties.
1552. Dasystoma pedicularia (L.) Benth. Fernleaf False Foxglove. Fulton County.
1553. Dasystoma flava (L.) Wood. Downy False Foxglove. Eastern Ohio, as far west as Cuyahoga, Fairfield, and Adams Counties.
1554. Dasystoma laevigata Raf. Entire-leaf False Foxglove. Jackson, Vinton, Hocking, Fairfield.
1555. Dasystoma virginica (L.) Britt. Smooth False Foxglove. Fulton, Wood, Fairfield, Adams.

1556. Agalinis purpurea (L.) Britt. Large Purple Gerardia. Montgomery, Fairfield, Franklin, Fulton, Erie, Wayne.
1557. Agalinis paupercula (Gr.) Britt. Small Purple Gerardia. Stark, Ottawa, Logan, Champaign, Gallia.
1558. Agalinis tenuifolia (Vahl.) Raf. Slender Gerardia. General.
1559. Agalinis skinneriana (Wood) Britt. Skinner's Gerardia. Greene County.
1560. Otophylla auriculata (Mx.) Small. Auricled Gerardia. Ottawa County.
1561. Castilleja coccinea (L.) Spreng. Scarlet Painted-cup. Franklin, Knox.
1562. Pedicularis lanceolata Mx. Lanceleaf Lousewort. Rather general, but no specimens from south of Montgomery and Hocking Counties.
1563. Pedicularis canadensis L. Wood Lousewort. General.
1564. Melampyrum lineare Lam. Narrow-leaf Cow-wheat. Lorain, Cuyahoga, Lake, Ashtabula, Geauga, Portage, Hocking.
1565. Antirrhinum majus L. Great Snapdragon. Madison County. From Europe.
1566. Linaria linaria (L.) Karst. Yellow Toadflax. General, but no specimens from the northwestern counties. Naturalized from Europe.
1657. Linaria canadensis (L.) Dum. Blue Toadflax. No specimens.
1568. Chaenorrhinum minus (L.) Lange. Lesser Toadflax. Portage County. From Europe.
1569. Kickxia spuria (L.) Dum. Roundleaf Toadflax. Lake County. From Europe.
1570. Kickxia elatine (L.) Dum. Sharp-pointed Toadflax. Lake County. From Europe.
1571. Cymbalaria cymbalaria (L.) Wettst. Kenilworth Ivy. Montgomery, Crawford. From Europe.

**Orobanchaceae.** Broom-rape Family.

1572. Thalesia uniflora (L.) Britt. Naked Broom-rape. Rather general, but no specimens from the northwestern counties.
1573. Orobanche ludoviciana Nutt. Louisiana Broom-rape. Hamilton County.
1574. Conopholis americana (L. f.) Wallr. Squaw-root. General.
1575. Leptamnium virginianum (L.) Raf. Beech-drops. General.

**Bignoniaceae.** Bignonia Family.

1576. Bignonia radicans L. Trumpet-creeper. General.
1577. Anisostichus capreolata (L.) Bur. Cross-vine. Lawrence, Adams.
1578. Catalpa catalpa (L.) Karst. Common Catalpa. Montgomery, Champaign, Franklin. From the South.
1579. Catalpa speciosa Ward. Hardy Catalpa. Ashtabula, Franklin, Hocking, Madison, Preble. From the Southwest.

**Martyniaceae.** Unicorn-plant Family.

1580. Martynia louisiana Mill. Unicorn-plant. Lorain, Richland, Franklin, Ross. Escaped from cultivation.

**Lentibulariaceae.** Bladderwort Family.

1581. Utricularia macrorhiza Le Conte. Greater Bladderwort. Northern part of state; specimens from as far south as Franklin and Licking Counties.
1582. Utricularia gibba L. Humped Bladderwort. Stark, Franklin, Fairfield, Erie, Defiance.
1583. Utricularia intermedia Hayne. Flatleaf Bladderwort. Lake, Wayne.
1584. Utricularia minor L. Lesser Bladderwort. Licking County.
1585. Stomoisia cornuta (Mx.) Raf. Horned Bladderwort. Summit County.

**Acanthaceae.** Acanthus Family.

1586. Ruellia strepens L. Smooth Ruellia. Western half of the state; also in Monroe County.
1587. Ruellia ciliosa Pursh. Hairy Ruellia. From Union County southward and westward; also in Cuyahoga County.
1588. Dianthera americana L. Water-willow. General.

Order, *Lamiales*.

**Boraginaceae.** Borage Family.

1589. Heliotropium indicum L. Indian Heliotrope. No specimens. From India.
1590. Cynoglossum officinale L. Hound's-tongue. General and abundant. Naturalized from Europe.
1591. Cynoglossum virginianum L. Wild Comfrey. Southeastern Ohio to Cuyahoga, Wyandot, and Warren Counties.

1592. Lappula lappula (L.) Karst. European Stickseed. Rather general. From Europe.

1593. Lappula virginiana (L.) Greene. Virginia Stickseed. General.

1594. Mertensia virginica (L.) DC. Virginia Cowslip. Rather general.

1595. Asperugo procumbens L. German Madwort. Lake County. From Europe.

1596. Myosotis laxa Lehm. Smaller Forget-me-not. Tuscarawas, Stark, Summit, Lake, Lucas.

1597. Myosotis arvensis (L.) Hill. Field Forget-me-not. Gallia, Franklin, Lake.

1598. Myosotis virginica (L.) B. S. P. Virginia Forget-me-not. Fairfield, Franklin, Lorain, Erie, Lucas.

1599. Lithospermum latifolium Mx. American Gromwell. Lawrence, Warren, Lucas, Auglaize.

1600. Lithospermum officinale L. Common Gromwell. No specimens. From Europe.

1601. Lithospermum arvense L. Corn Gromwell. General and abundant. Naturalized from Europe.

1602. Lithospermum carolinense (Walt.) MacM. Hairy Puccoon. Erie, Lucas.

1603. Lithospermum canescens (Mx.) Lehm. Hoary Puccoon. Rather general; no specimens from the eastern counties.

1604. Onosmodium hispidissimum Mack. Shaggy False Gromwell. Lorain, Ottawa, Lucas, Greene, Clark, Montgomery, Adams.

1605. Symphytum officinale L. Common Comfrey. Northern part of Ohio; as far south as Belmont and Champaign Counties. From Europe.

1606. Lycopsis arvensis L. Small Bugloss. Stark County. From Europe.

1607. Echium vulgare L. Blueweed. Montgomery, Clinton, Richland, Cuyahoga, Columbiana, Noble, Belmont. From Europe.

**Verbenaceae.** Vervain Family.

1608. Verbena urticifolia L. White Vervain. General and abundant.

1609. Verbena hastata L. Blue Vervain. General and abundant.

1610. Verbena angustifolia Mx. Narrowleaf Vervain. Lake, Cuyahoga, Erie, Ottawa, Auglaize, Madison, Montgomery, Clermont, Adams, Meigs.

1611. Verbena stricta Vent. Hoary Vervain. Hamilton, Clermont, Highland, Warren, Preble, Montgomery, Clark, Franklin, Licking, Cuyahoga, Lake.

1612. Verbena bracteosa Mx. Bracted Vervain. Pike, Hamilton, Montgomery, Auglaize, Wyandot, Cuyahoga, Ashtabula.

1613. Verbena canadensis (L.) Britt. Large-flowered Verbena. Ross, Franklin, Auglaize.

1614. Lippia lanceolate Mx. Frog-fruit. General; no specimens from the eastern counties.

**Lamiaceae.** Mint Family.

1615. Isanthus brachiatus (L.) B. S. P. False Pennyroyal. Erie, Ottawa, Clark, Warren, Franklin, Muskingum, Hocking, Morgan, Gallia.

1616. Trichostema dichotomum L. Blue-curls. Hamilton, Fairfield, Jackson, Monroe, Highland.

1617. Ajuga reptans L. Bungle-weed. No specimens. From Europe.

1618. Teucrium canadense L. American Germander. General and abundant.

1619. Teucrium occidentale Gr. Hairy Germander. Lake, Wayne, Erie, Ottawa, Auglaize, Clark, Greene, Perry, Monroe.

1620. Teucrium scorodonia L. Wood Germander. Lake County. From Europe.

1621. Teucrium botrys L. Cutleaf Germander. No specimens. From Europe.

1622. Scutellaria lateriflora L. Mad-dog Skullcap. General.

1623. Scutellaria serrata Andr. Showy Skullcap. Gallia County.

1624. Scutellaria incana Muhl. Downy Skullcap. Eastern and southern Ohio; from Cuyahoga and Wayne Counties eastward and from Perry and Miami Counties southward.

1625. Scutellaria cordifolia Muhl. Heartleaf Skullcap. Rather general.

1626. Scutellaria pilosa Mx. Hairy Skullcap. No specimens.

1627. Scutellaria integrifolia L. Hyssop Skullcap. Jackson County.

1628. Scutellaria parvula Mx. Small Skullcap. Ottawa, Madison, Clark, Hamilton, Gallia, Franklin, Greene, Montgomery, Scioto.

1629. Scutellaria saxatilis Ridd. Rock Skullcap. No specimens.

1630. Scutellaria galericulata L. Marsh Skullcap. Rather general; no specimens south of Clark and Perry Counties.

1631. Scutellaria nervosa Pursh. Veined Skullcap. Rather general.
1632. Marrubium vulgare L. Common Hoarhound. General. Naturalized from Europe.
1633. Hedeoma pulegioides (L.) Pers. American Pennyroyal. General and abundant.
1634. Hedeoma hispida Pursh. Rough Pennyroyal. (Moseley Herbarium—Lorain County.)
1635. Melissa officinalis L. Lemon Balm. Rather general; no specimens from the northwestern counties. From Europe.
1636. Satureia hortensis L. Summer Savory. Ottawa, Lake. From Europe.
1637. Clinopodium vulgare L. Field Basil. Rather general; no specimens from southeastern and northwestern counties.
1638. Clinopodium glabrum (Nutt.) Ktz. Low Calamint. Ottawa, Erie, Union, Greene.
1639. Koellia virginiana (L.) MacM. Virginia Mountain-mint. Rather general.
1640. Koellia flexuosa (Walt.) MacM. Narrowleaf Mountain-mint. Rather general.
1641. Koellia pilosa (Nutt.) Britt. Hairy Mountain-mint. Cuyahoga, Stark, Hocking, Clark, Shelby.
1642. Koellia incana (L.) Ktz. Hoary Mountain-mint. Stark, Fairfield, Hocking, Jackson, Gallia, Scioto, Adams.
1643. Koellia mutica (L.) Britt. Short-toothed Mountain-mint. Licking, Cuyahoga.
1644. Origanum vulgare L. Wild Majoram. Hocking County. From Europe.
1645. Thymus serpyllum L. Creeping Thyme. Coshocton, Gallia. From Europe.
1646. Cunila origanoides (L.) Britt. American Dittany. Southeastern Ohio to Tuscarawas, Fairfield, Ross, and Adams Counties.
1647. Lycopus virginicus L. Virginia Water-hoarhound. Rather general.
1648. Lycopus uniflorus Mx. Northern Water-hoarhound. Belmont County.
1649. Lycopus rubellus Moench. Stalked Water-hoarhound. Geauga, Wayne, Cuyahoga, Erie, Huron, Paulding, Auglaize, Fairfield, Clinton, Montgomery.
1650. Lycopus americanus Muhl. Cutleaf Water-hoarhound. General

1651. Mentha spicata L. Spearmint. General. Naturalized from Europe.

1652. Mentha piperita L. Peppermint. General. Naturalized from Europe.

1653. Mentha citrata Ehrh. Bergamot Mint. Lake, Franklin. From Europe.

1654. Mentha longifolia (L.) Huds. European Mint. Lake County. From Europe.

1655. Mentha rotundifolia (L.) Huds. Roundleaf Mint. Franklin County—a waif. From Europe.

1656. Mentha alopecuroides Hull. Woolly Mint. Franklin County. From Europe.

1657. Mentha arvensis L. Field Mint. Lake County. From Europe.

1658. Mentha cardiaca Gerarde. Small-leaf Mint. Montgomery County. From Europe.

1659. Mentha canadensis L. American Wild Mint. General.

1660. Collinsonia canadensis L. Stone-root. General.

1661. Perilla frutescens (L.) Britt. Perilla. Warren County. Native of India.

1662. Agastache nepetoides (L.) Ktz. Catnip Giant-hyssop. General.

1663. Agastache scrophulariaefolia (Willd.) Ktz. Figwort Giant-hyssop. Medina, Stark, Auglaize, Champaign, Madison, Hocking.

1664. Nepeta cataria L. Catnip. General and abundant. Naturalized from Europe.

1665. Glecoma hederacea L. Ground Ivy. General and abundant. Naturalized from Europe.

1666. Prunella vulgaris L. Common Self-heal. General and abundant. Native of Europe.

1667. Dracocephalum virginianum L. Virginia Dragon-head. Rather general.

1668. Synandra hispidula (Mx.) Britt. Synandra. Belmont, Wyandot, Franklin, Miami, Hamilton, Clermont, Lawrence.

1669. Galeopsis tetrahit L. Hemp-nettle. Lake County. From Europe.

1670. Leonurus cardiaca L. Common Motherwort. General and abundant. Naturalized from Europe.

1671. Lamium amplexicaule L. Common Henbit. Rather general. From Europe.

1672. Lamium purpureum L. Red Henbit. Warren, Erie, Lorain. From Europe.
1673. Lamium maculatum L. Spotted Henbit. Washington, Miami, Knox, Marion, Auglaize, Lorain. From Europe.
1674. Lamium album L. White Henbit. Miami, Lorain. From Europe.
1675. Stachys palustris L. Marsh Hedge-nettle. Rather general.
1676. Stachys tenuifolia Willd. Smooth Hedge-nettle. Rather general.
1677. Stachys asper Mx. Rough Hedge-nettle. Rather general.
1678. Stachys cordata Ridd. Cordate Hedge-nettle. Southern Ohio, as far north as Noble, Franklin, and Auglaize Counties.
1679. Blephilia ciliata (L.) Raf. Downy Blephilia. Northern part of the state; as far south as Harrison, Franklin, and Montgomery Counties.
1680. Blephilia hirsuta (Prush) Torr. Hairy Blephilia. General.
1681. Monarda punctata L. Horsemint. No specimens.
1682. Monarda didyma L. American Beebalm. Trumbull, Portage, Cuyahoga, Medina, Madison.
1683. Monarda clinopodia L. Basil Balm. General.
1684. Monarda fistulosa L. Wild Bergamot. General and abundant.
1685. Monarda mollis L. Canescent Wild Bergamot. Rather general.
1686. Salvia lyrata L. Lyreleaf Sage. Pike, Lawrence, Gallia, Meigs.
1687. Salvia lanceifolia Poir. Lanceleaf Sage. Franklin County. From the West.
1688. Salvia verbenaca L. Wild Sage. No specimens. From Europe.
1689. Salvia officinalis L. Common Sage. Stark County. Escaped.

**Phrymaceae.** Lopseed Family.

1690. Phryma leptostachya L. Lopseed. General.

Order, *Plantaginales.*

**Plantaginaceae.** Plaintain Family.

1691. Plantago cordata Lam. Heartleaf Plantain. Lucas, Auglaize, Madison, Franklin.
1692. Plantago rugellii Dec. Rugel's Plantain. General and abundant.
1693. Plantago major L. Common Plantain. Rather general.
1694. Plantago lanceolata L. Ribgrass Plantain. General and abundant. Naturalized from Europe.
1695. Plantago aristata Mx. Large-bracted Plantain. Rather general.

1696. Plantago virginica L. Dwarf Plantain. Gallia, Jackson, Pike, Ross, Stark, Cuyahoga, Lake.

1697. Plantago arenaria W. & K. Sand Plantain. Montgomery County. From Europe.

Subclass, INFERAE.

Order, *Umbellales*.

**Araliaceae.** Ginseng Family.

1698. Aralia spinosa L. Angelica-tree. Clermont, Hocking.

1699. Aralia racemosa L. American Spikenard. General.

1700. Aralia nudicaulis L. Wild Sarsaparilla. Northern part of state, as far south as Licking County.

1701. Aralia hispida Vent. Bristly Sarsaparilla. Lake, Cuyahoga.

1702. Panax quinquefolium L. Common Ginseng. General.

1703. Panax trifolium L. Dwarf Ginseng. Columbiana, Cuyahoga, Lorain, Medina, Seneca, Richland.

**Ammiaceae.** Carrot Family.

1704. Eryngium aquaticum L. Rattlesnake-master. Wyandot, Erie.

1705. Sanicula marylandica L. Black Snakeroot. Rather general.

1706. Sanicula gregaria Bickn. Clustered Snakeroot. Rather general

1707. Sanicula canadensis L. Short-styled Snakeroot. General and abundant.

1708. Sanicula trifoliata Bickn. Large-fruited Snakeroot. Southern and eastern part of state to Geauga, Morrow, and Preble Counties.

1709. Deringa canadensis (L.) Ktz. Honewort. General.

1710. Chaerophyllum procumbens (L.) Crantz. Spreading Chervil. General.

1711. Washingtonia claytoni (Mx.) Britt. Woolly Sweet-cicely. General.

1712. Washingtonia longistylis (Torr.) Britt. Long-styled Sweet-cicely. General.

1713. Scandix pecten-veneris L. Venus'-comb. Lake County. From Europe.

1714. Pastinaca sativa L. Wild Parsnip. General and abundant. Naturalized from Europe.

1715. Heracleum lanatum Mx. Cow-parsnip. Rather general.

1716. Conioselium chinense (L.) B. S. P. Hemlock-parsley. Lake, Summit.

1717. Angelica atropurpurea L. Purple-stemmed Angelica. Rather general.

1718. Angelica villosa (Walt.) B. S. P. Pubescent Angelica. Eastern half of state, west to Adams, Fairfield and Richland Counties.

1719. Oxypolis rigidus (L.) Raf. Cowbane. Hamilton, Clark, Franklin, Erie, Fulton, Champaign, Huron, Montgomery, Madison.

1720. Bupleurum rotundifolium L. Hare's-ear. Warren County. From Europe.

1721. Thaspium trifoliatum (L.) Britt. Purple Meadow-parsnip. General.

1722. Thaspium barbinode (Mx.) Nutt. Hairy-jointed Meadow-parsnip. General.

1723. Taenidia integerrima (L.) Drude. Yellow Pimpernel. General.

1724. Zizia aurea (L.) Koch. Early Meadow-parsnip. Rather general.

1725. Zizia cordata (Walt.) DC. Heartleaf Meadow-parsnip. Lorain, Richland, Wyandot, Madison, Franklin, Warren, Gallia, Washington.

1726. Apium petroselinum L. Parsley. Madison County. Escaped from cultivation.

1727. Foeniculum foeniculum (L.) Karst. Fennel. Hocking, Scioto. From Europe.

1728. Aethusa cynapium L. Fool's Parsley. Lake County. From Europe.

1729. Hydrocotyle umbellata L. Umbellate Marsh-pennywort. Portage, Stark.

1730. Hydrocotyle americana L. American Marsh-pennywort. Cuyahoga, Summit, Wayne, Stark.

1731. Erigenia bulbosa (Mx.) Nutt. Harbenger-of-spring. General.

1732. Conium maculatum L. Poison-hemlock. Montgomery, Knox, Lake. From Europe.

1733. Aegopodium podagraria L. Goutweed. Lake County. From Europe.

1734. Eulophus americanus Nutt. Eastern Eulophus. No specimens.

1735. Pimpinella saxifraga L. Pimpernel. No specimens. From Europe.

1736. Sium cicutaefolium Schrank. Water-parsnip. General, but no specimens from the southern counties.

1737. Cicuta maculata L. Spotted Water-hemlock. General.

1738. Cicuta bulbifera L. Bulb-bearing Water-hemlock. Northern part of state south to Perry and Clark Counties.

1739. Carum carui L. Caraway. Columbiana, Ashland, Lorain, Fulton. From Europe.

1740. Daucus carota L. Wild Carrot. General and abundant. Naturalized from Europe.

1741. Torilis anthriscus (L.) Gmel. Erect Hedge-parsley. Hamilton County. From Europe.

**Cornaceae.** Dogwood Family.

1742. Cornus alternifolia L. f. Blue Dogwood. General.

1743. Cornus femina Mill. Panicled Dogwood. General in the northern half of the state.

1744. Cornus stolonifera Mx. Red-osier Dogwood. General in the northern part of the state, south to Stark, Morrow, and Montgomery Counties.

1745. Cornus asperifolia Mx. Roughleaf Dogwood. General.

1746. Cornus amomum Mill. Silky Dogwood. General and abundant.

1747. Cornus rugosa Lam. Roundleaf Dogwood. Cuyahoga, Summit, Warren.

1748. Cynoxylon floridum (L.) Raf. Flowering Dogwood. General and abundant.

1749. Cynoxylon canadense (L.) Dwarf Dogwood. Stark, Licking.

1750. Nyssa sylvatica Marsh. Tupelo. General.

Order, *Rubiales.*

**Rubiaceae.** Madder Family.

1751. Houstonia coerulea L. Bluets. Southeastern two-thirds of the state as far northwest as Cuyahoga, Crawford, Clark, and Hamilton Counties.

1752. Houstonia purpurea L. Large Houstonia. Clermont, Butler, Highland, Warren.

1753. Houstonia ciliolata Torr. Fringed Houstonia. Lawrence, Licking, Franklin, Delaware, Defiance, Lucas, Ottawa, Cuyahoga, Lake.

1754. Houstonia longifolia Gaertn. Longleaf Houstonia. Rather general, but Ottawa the only northern county represented in the herbarium.

1755. Houstonia tenuifolia Nutt. Slenderleaf Houstonia. No specimens.

1756. Houstonia angustifolia Mx. Narrowleaf Houstonia. Ottawa County.

1757. Cephalanthus occidentalis L. Button-bush. General and abundant.

1758. Michella repens L. Partridge-berry. Rather general.

1759. Spermacoce glabra Mx. Smooth Buttonweed. No specimens.

1760. Diodia teres Walt. Rough Buttonweed. Lake County.

1761. Galium pilosum Ait. Hairy Bedstraw. Eastern Ohio; as far west as Lorain, Knox, Fairfield, and Adams Counties.

1762. Galium lanceolatum Torr. Lanceleaf Wild Licorice. Rather general.

1763. Galium circaezans Mx. Wild Licorice. General and abundant.

1764. Galium boreale L. Northern Bedstraw. Ottawa, Lorain.

1765. Galium triflorum Mx. Fragrant Bedstraw. General.

1766. Galium mollugo L. White Bedstraw. Lake, Fayette. From Europe.

1767. Galium tinctorium L. Stiff Marsh Bedstraw. Rather general.

1768. Galium trifidum L. Small Bedstraw. Northern Ohio, as far south as Shelby, Madison, Perry, and Harrison Counties.

1769. Galium claytoni Mx. Clayton's Bedstraw. Erie County.

1770. Galium concinnum T. & G. Shining Bedstraw. General and abundant.

1771. Galium asprellum Mx. Rough Bedstraw. Rather general; no specimens from the southern counties.

1772. Galium aparine L. Common Cleavers. General and abundant.

1773. Sherardia arvensis L. Blue Field-madder. Cuyahoga County. From Europe.

**Caprifoliaceae.** Honeysuckle Family.

1774. Sambucus canadensis L. Common Elderberry. General and abundant.

1775. Sambucus racemosa L. Red Elderberry. Rather general.

1776. Viburnum pubescens (Ait.) Pursh. Downy Arrow-wood. Lorain, Erie, Wyandot, Auglaize, Williams.

1777. Viburnum dentatum L. Toothed Arrow-wood. Ashtabula, Geauga, Lorain, Summit, Stark, Wayne, Ashland, Tuscarawas.

1778. Viburnum scabrellum (T. & G.) Chapm. Roughleaf Arrow-wood. Adams, Brown, Hocking, Madison.

1779. Viburnum cassinoides L. Withe-rod. Ashtabula, Geauga, Cuyahoga, Summit, Lorain, Hocking.

1780. Viburnum lentago L. Sheepberry. Rather general.

1781. Viburnum prunifolium L. Black Haw. General.

1782. Viburnum lantana L. Wayfaring-tree. Lake County. From Europe.

1783. Viburnum acerifolium L. Mapleleaf Arrow-wood. General.

1784. Viburnum opulus L. Cranberry-tree. Lake, Geauga, Champaign.

1785. Viburnum alnifolium Marsh. Hobblebush. Ashtabula, Lake

1786. Triosteum angustifolium L. Yellow Horse-gentian. Cuyahoga, Warren, Clermont.

1787. Triosteum perfoliatum L. Common Horse-gentian. General.

1788. Symphoricarpos racemosus Mx. Snowberry. Rather general.

1789. Symphoricarpos symphoricarpos (L.) MacM. Coralberry. General.

1790. Lonicera canadensis Marsh. American Fly Honeysuckle. Lake, Summit, Cuyahoga, Lorain.

1791. Lonicera oblongifolia (Goldie) Hook. Swamp Fly Honeysuckle. Cuyahoga County.

1792. Lonicera tartarica L. Tartarian Honeysuckle. Ashtabula, Lake, Cuyahoga, Lorain, Licking, Franklin, Auglaize. Escaped from cultivation.

1793. Lonicera xylosteum L. European Fly Honeysuckle. Lake County. Native of Europe.

1794. Lonicera japonica Thunb. Japanese Honeysuckle. Adams, Brown, Auglaize. Escaped from cultivation.

1795. Lonicera sempervirens L. Trumpet Honeysuckle. Cuyahoga County.

1796. Lonicera caprifolium L. Italian Honeysuckle. No specimens. From Europe.

1797. Lonicera hirsuta Eaton. Hairy Honeysuckle. Ottawa, Lorain, Monroe.

1798. Lonicera glaucescens Rydb. Glauscent Honeysuckle. General.

1799. Lonicera sullivantii Gr. Sullivant's Honeysuckle. Stark, Muskingum, Franklin, Madison, Clark, Highland.

1800. Lonicera dioica L. Smoothleaf Honeysuckle. Champaign, Franklin.

1801. Linnaea americana Forbes. American Twin-flower. Stark County.

1802. Diervilla diervilla (L.) MacM. Bush-honeysuckle. Lucas, Lorain, Summit, Wayne, Stark, Franklin.

**Valerianaceae.** Valerian Family.

1803. Valerianella locusta (L.) Bettke. European Corn-salad. Hamilton, Ross, Lorain, Cuyahoga. From Europe.

1804. Valerianella chenopodifolia (Pursh.) DC. Goosefoot Corn-salad. Rather general.

1805. Valerianella radiata (L.) Dufr. Beaked Corn-salad. General.

1806. Valerianella woodsiana (T. & G.) Walp. Wood's Corn-salad. Erie, Richland, Franklin, Clark.

1807. Valeriana pauciflora Mx. Large-flowered Valerian. Western half of Ohio, as far east as Ottawa, Franklin, and Lawrence Counties.

1808. Valeriana edulis Nutt. Edible Valerian. Champaign County.

1809. Valeriana officinalis L. Garden Valerian. Ashtabula, Lake. From Europe.

Order, *Campanulales.*

**Campanulaceae.** Bellflower Family.

1810. Campanula rapunculoides L. European Bellflower. Cuyahoga, Lorain, Auglaize, Crawford, Carroll, Franklin, Hamilton. From Europe.

1811. Campanula americana L. Tall Bellflower. General and abundant.

1812. Campanula rotundifolia L. Harebell. Ottawa County.

1813. Campanula aparinoides Pursh. Marsh Bellflower. Rather general; no specimens from the southeastern and northwestern counties.

1814. Specularia perfoliata (L.) DC. Venus'-looking-glass. General

**Lobeliaceae.** Lobelia Family.

1815. Lobelia cardinalis L. Cardinal Lobelia. General.

1816. Lobelia syphalitica L. Blue Lobelia. General and abundant.
1817. Lobelia puberula Mx. Downy Lobelia. Gallia, Meigs, Hocking.
1818. Lobelia spicata Lam. Pale Spiked Lobelia. General.
1819. Lobelia leptostachys A. DC. Spiked Lobelia. Adams, Gallia, Meigs, Hocking, Fairfield, Clark.
1820. Lobelia inflata L. Indian-tobacco. General.
1821. Lobelia kalmii L. Kalm's Lobelia. General.

Order, *Compositales.*

**Dipsacaceae.** Teazel Family.

1822. Dipsacus sylvestris Huds. Wild Teazel. General and abundant. Naturalized from Europe.

**Ambrosiaceae.** Ragweed Family.

1823. Xanthium pennsylvanicum Wallr. Pennsylvania Cocklebur. General.
1824. Xanthium americanum Walt. American Cocklebur. Athens, Vinton, Washington.
1825. Xanthium spinosum L. Spiny Cocklebur. Montgomery County. Introduced.
1826. Ambrosia trifida L. Giant Ragweed. General.
1827. Ambrosia psilostachya DC. Western Ragweed. Franklin, Lake. Introduced from the West.
1828. Ambrosia elatior L. Roman Ragweed. General and abundant.

**Helianthaceae.** Sunflower Family.

1829. Heliopsis helianthoides (L.) Sw. Smooth Oxeye. General and abundant.
1830. Heliopsis scabra Dunal. Rough Oxeye. Erie, Wyandot, Wayne. Madison, Ross.
1831. Verbesina alba L. Verbesina. Rather general.
1832. Rudbeckia triloba L. Thinleaf Cone-flower. Rather general; no specimens from the eastern counties.
1833. Rudbeckia hirta L. Black-eyed-Susan. General and abundant.
1834. Rudbeckia fulgida Ait. Orange Cone-flower. Franklin, Union.
1835. Rudbeckia speciosa Wend. Showy Cone-flower. Montgomery, Champaign, Madison, Franklin.
1835a. Rudbeckia speciosa sullivanti (Boy. & Bead.) Rob. No specimens.

1836. Rudbeckia laciniata L. Tall Cone-flower. General.

1837. Ratibida pinnata (Vent.) Barnh. Tall Nigger-head. Rather general.

1838. Ratibida columnaris (Sims.) D. Don. Prairie Nigger-head. A waif in Franklin County.

1839. Echinacea purpurea (L.) Moench. Purple Cone-flower. Clark, Madison, Franklin, Holmes, Lucas.

1840. Helianthus occidentalis Ridd. Fewleaf Sunflower. Fulton. Erie, Franklin.

1841. Helianthus microcephalus T. & G. Small Wood Sunflower. Rather general.

1842. Helianthus giganteus L. Giant Sunflower. From Erie, Richland, and Fairfield Counties westward.

1843. Helianthus maximiliani Schrad. Maximilian's Sunflower. Lake, Franklin. From the West.

1844. Helianthus grosse-serratus Mart. Sawtooth Sunflower. Cuyahoga, Erie, Huron, Wood, Auglaize, Clark, Madison.

1845. Helianthus kellermani Britt. Kellerman's Sunflower. Franklin County.

1846. Helianthus divaricatus L. Woodland Sunflower. Rather general.

1847. Helianthus mollis. Lam. Hairy Sunflower. Erie, Franklin.

1848. Helianthus doronicoides Lam. Oblong-leaf Sunflower. Rather general; no specimens from the eastern and southeastern counties.

1849. Helianthus decapetalus L. Thinleaf Sunflower. Rather general.

1850. Helianthus tracheliifolius Mill. Throatwort Sunflower. Rather general; no specimens from the southeastern third of Ohio.

1851. Helianthus strumosus L. Paleleaf Wood Sunflower. Rather general; no specimens from the southeastern third of the state.

1852. Helianthus hirsutus Raf. Hirsute Sunflower. General.

1853. Helianthus laetiflorus Pers. Showy Sunflower. Franklin, Wayne.

1854. Helianthus tuberosus L. Jerusalem Artichoke. General.

1855. Helianthus annuus L. Common Sunflower. Rather general. From the West.

1856. Helianthus petiolaris Nutt. Prairie Sunflower. Lake County. From the West.

1857. Phaethusa helianthoides (Mx.) Britt. Sunflower Crownbeard. Madison, Clark, Adams.

1858. Ridan alternifolius (L.) Britt. Ridan. General.

1859. Coreopsis lanceolata L. Lance-leaf Tickseed. Franklin County.

1860. Coreopsis tripteris L. Tall Tickseed. Rather general.

1861. Coreopsis major Walt. Greater Tickseed. Gallia, Lawrence, Scioto.

1862. Coreopsis verticillata L. Whorled Tickseed. No specimens.

1863. Coreopsis tinctoria Nutt. Garden Tickseed. Montgomery, Franklin, Cuyahoga. From the West.

1864. Bidens laevis (L.) B. S. P. Smooth Bur-marigold. Columbiana, Erie, Logan, Hamilton.

1865. Bidens cernua L. Nodding Bur-marigold. General.

1866. Bidens connata Muhl. Swamp Bur-marigold. Rather general.

1867. Bidens comosa (Gr.) Wieg. Leafy-bracted Bur-marigold. Auglaize, Delaware, Franklin, Vinton, Belmont.

1868. Bidens discoidea (T. & G.) Britt. Small Beggar-ticks. Erie County.

1869. Bidens frondosa L. Black Beggar-ticks. Meigs, Vinton, Holmes.

1870. Bidens vulgata Greene. Tall Beggar-ticks. General.

1871. Bidens bipinnata L. Spanish-needles. Rather general; no specimens from the northwestern counties.

1872. Bidens trichosperma (Mx.) Britt. Tall Tickseed. General.

1873. Bidens aristosa (Mx.) Britt. Western Tickseed. Wyandot. Champaign, Clark, Madison.

1874. Megalodonta beckii (Torr.) Greene. Water-marigold. Erie, Stark.

1875. Galinsoga parviflora Cav. Galinsoga. Lake, Cuyahoga, Licking, Belmont, Columbiana, Jefferson, Monroe, Franklin, Montgomery. From tropical America.

1876. Polymnia uvedalia L. Yellow Leaf-cup. Cuyahoga, Noble, Gallia, Lawrence, Clermont, Clark.

1877. Polymnia canadensis L. Small-flowered Leaf-cup. General.

1878. Silphium integrifolium Mx. Entire-leaf Rosin-weed. No specimens.

1879. Silphium trifoliatum L. Whorled Rosin-weed. Rather general; no specimens from the northwestern counties.

1880. Silphium laciniatum L. Compass-plant. Summit County

1881. Silphium perfoliatum L. Indian-cup. General.

1882. Silphium terebinthinaceum Jacq. Prairie Dock (Rosin-weed). Cuyahoga, Wayne, Erie, Ottawa, Lucas, Fulton, Defiance, Hancock, Champaign, Clark, Madison.

1883. Parthenium hysterophorus L. Parthenium. A waif in Franklin County.

1884. Tetraneuris herbacea Greene. Eastern Tetraneuris. Ottawa County.

1885. Helenium autumnale L. Common Sneezeweed. Rather general; no specimens from the southeastern counties.

1886. Helenium nudiflorum Nutt. Purple-headed Sneezeweed. Lake, Franklin.

1887. Helenium tenuifolium Nutt. Slender-leaf Sneezeweed. Franklin, Lake.

1888. Boebera papposa (Vent.) Rydb. Fetid Marigold. Franklin, Delaware, Logan, Madison, Hamilton. From the West.

1889. Inula helenium L. Elecampane. General, but no specimens from the southernmost counties. From Europe.

1890. Gifola germanica (L.) Dum. Herb Impius. Guernsey County. From Europe.

1891. Gnaphalium obtusifolium L. Fragrant Cudweed. General.

1892. Gnaphalium decurrens Ives. Clammy Cudweed. Cuyahoga County.

1893. Gnaphalium uliginosum L. Marsh Cudweed. General.

1894. Gnaphalium purpureum L. Purplish Cudweed. Rather general.

1895. Anaphalis margaritacea (L.) Benth. & Hook. Pearly Everlasting. Cuyahoga County.

1896. Antennaria parlinii Fern. Parlin's Everlasting. General.

1897. Antennaria solitaria Rydb. Single-headed Everlasting. Lawrence County.

1898. Antennaria plantaginifolia (L.) Rich. Plantain-leaf Everlasting. General.

1899. Antennaria neodioica Greene. Smaller Everlasting. Lake, Auglaize.

1900. Antennaria neglecta Greene. Field Everlasting. Rather general.

1901. Grindelia squarrosa (Pursh) Dun. Broadleaf Gum-plant. Hamilton County. From the West.

1902. Chrysopsis graminifolia (Mx.) Ell. Grassleaf Golden-aster. No specimens.

1903. Chrysopsis mariana (L.) Nutt. Maryland Golden-aster. Hocking, Jackson.

1904. Solidago squarrosa Muhl. Stout Goldenrod. Ashtabula, Lake, Cuyahoga.

1905. Solidago caesia L. Wreath Goldenrod. General.

1906. Solidago flexicaulis L. Zig-zag Goldenrod. Eastern Ohio, as far west as Cuyahoga, Fairfield, Jackson, and Lawrence Counties; also in Ottawa County.

1907. Solidago bicolor L. White Goldenrod. Columbiana, Geauga, Cuyahoga, Summit, Wayne, Erie, Fairfield, Vinton, Jackson, Lawrence.

1908. Solidago hispida Muhl. Hairy Goldenrod. Ottawa, Lake.

1909. Solidago erecta Pursh. Slender Goldenrod. Fairfield, Hocking, Meigs.

1910. Solidago uliginosa Nutt. Bog Goldenrod. Lucas, Portage, Stark, Wayne, Licking, Franklin.

1911. Solidago speciosa Nutt. Showy Goldenrod. Lucas, Franklin, Fairfield, Lawrence.

1912. Solidago rigidiuscula (T. & G.) Port. Slender Showy Goldenrod. Erie, Wyandot, Wood, Lucas, Fulton.

1913. Solidago rugosa Mill. Wrinkle-leaf Goldenrod. Rather general.

1914. Solidago patula Muhl. Roughleaf Goldenrod. Rather general.

1915. Solidago ulmnifolia Muhl. Elmleaf Goldenrod. Rather general.

1916. Solidago neglecta T. & G. Swamp Goldenrod. Wood, Madison, Fairfield.

1917. Solidago juncea Ait. Plume Goldenrod. Rather general.

1918. Solidago arguta Ait. Cutleaf Goldenrod. Erie County.

1919. Solidago canadensis L. Canada Goldenrod. General and abundant.

1920. Solidago serotina Ait. Late Goldenrod. General.

1921. Solidago nemoralis Ait. Gray Goldenrod. General.

1922. Solidago rigida L. Stiff Goldenrod. Erie, Ottawa, Lucas, Defiance, Auglaize, Madison, Franklin, Lawrence.

1923. Solidago ohioensis Ridd. Ohio Goldenrod. Stark, Erie, Wyandot, Franklin, Champaign, Clark, Montgomery.

1924. Solidago riddellii Frank. Riddell's Goldenrod. Lucas, Fulton, Wyandot, Franklin, Madison, Clark.

1925. Euthamia graminifolia (L.) Nutt. Bushy Fragrant Goldenrod. General.

1926. Euthamia tenuifolia (Pursh.) Greene. Slender Fragrant Goldenrod. Erie, Lucas, Cuyahoga, Lake.

1927. Bellis perennis L. European Daisy. Lake, Cuyahoga. From Europe.

1928. Boltonia asteroides (L.) L'Her. Boltonia. Erie, Ottawa, Lucas, Auglaize, Paulding, Defiance.

1929. Sericocarpus linifolius (L.) B. S. P. Narrowleaf Whitetop Aster. No specimens.

1930. Sericocarphus asteroides (L.) B. S. P. Toothed Whitetop Aster. Cuyahoga, Summit, Wayne, Holmes, Fairfield, Hocking, Jackson, Gallia, Lawrence.

1931. Aster divaricatus L. White Wood Aster. Meigs, Franklin, Fairfield, Lorain, Erie.

1932. Aster macrophyllus L. Largeleaf Aster. Rather general; no specimens from the southwestern counties.

1933. Aster shortii Hook. Short's Aster. From Franklin and Montgomery Counties southward; also in Lake and Ottawa Counties.

1934. Aster azureus Lindl. Azure Aster. Franklin, Wood, Fulton, Erie.

1935. Aster cordifolius L. Common Blue Wood Aster. Rather general.

1936. Aster lowrieanus Port. Lowrie's Aster. Lake, Cuyahoga, Auglaize, Fairfield, Hamilton.

1937. Aster lindleyanus T. & G. Lindley's Aster. Wayne, Franklin.

1938. Aster drummondii Lindl. Drummond's Aster. Madison County.

1939. Aster safittifolium Willd. Arrowleaf Aster. Rather general.

1940. Aster undulatus L. Wavy-leaf Aster. Wayne County.

1941. Aster patens Ait. Late Purple Aster. Wayne County.

1942. Aster phlogifolius Muhl. Thinleaf Purple Aster. Wayne, Portage.

1943. Aster novae-angliae L. New England Aster. General.

1944. Aster oblongifolius Nutt. Aromatic Aster. No specimens.

1945. Aster puniceus L. Purple-stem Aster. Rather general.

1946. Aster prenanthoides Muhl. Crooked-stem Aster. Rather general.

1947. Aster laevis L. Smooth Aster. Rather general.

1948. Aster junceus Ait. Rush Aster. Licking, Wayne.

1949. Aster lateriflorus (L.) Britt. Starved Aster. Rather general.

1950. Aster hirsuticaulis Lindl. Roughstem Aster. Warren, Auglaize.

1951. Aster vimineus Lam. Small White Aster. Wayne County.

1952. Aster multiflorus Ait. Dense-flowered Aster. Lucas, Erie, Gallia.

1953. Aster dumosus L. Bushy Aster. Erie County.

1954. Aster salicifolius Lam. Willow Aster. Wayne County.

1955. Aster paniculatus Lam. Panicled Aster. General.

1956. Aster tradescanti L. Tradescant's Aster. Rather general.

1957. Aster faxoni Porter. Faxon's Aster. Vinton County.

1958. Aster ericoides L. White Heath Aster. General.

1958a. Aster ericoides platyphyllus T. & G. Western half of state, east to Erie, Franklin, and Meigs Counties.

1959. Aster ptarmicoides (Nees.) T. & G. Upland White Aster. (Ottawa County—Moseley Herbarium.)

1960. Erigeron pulchellus Mx. Showy Fleabane. General.

1961. Erigeron philadelphicus L. Philadelphia Fleabane. General.

1962. Erigeron annuus (L.) Pers. White-top Fleabane. General.

1963. Erigeron ramosus (Walt.) B. S. P. Daisy Fleabane. General.

1964. Leptilon canadense (L.) Britt. Common Horseweed. General.

1965. Doellingeria umbellata (Mill.) Nees. Tall White-top Aster. Rather general.

1966. Doellingeria infirma (Mx.) Greene. Infirm Aster. Portage County.

1967. Ionactis linariifolius (L.) Greene. Stiffleaf Aster. Adams, Hocking.

1968. Eupatorium maculatum L. Spooted Joe-Pye-weed. General.

1969. Eupatorium purpureum L. Joe-Pye-weed. General.

1970. Eupatorium serotinum Mx. Late-flowering Thoroughwort. Hamilton County.

1971. Eupatorium altissimum L. Tall Thoroughwort. Hamilton, Montgomery, Franklin, Erie, Lucas.

1972. Eupatorium sessilifolium L. Upland Boneset. Southeastern half of state, to Montgomery, Franklin, Wayne, Portage and Hamilton Counties.

1973. Eupatorium rotundifolium L. Roundleaf Thoroughwort. Hocking County.

1974. Eupatorium perfoliatum L. Common Boneset. General.

1975. Eupatorium urticaefolium Reich. White Snake-root. General.

1976. Eupatorium aromaticum L. Smaller White Snake-root. Hocking County.

1977. Eupatorium coelestinum L. Mist-flower. Southern Ohio; north to Hamilton, Fairfield, and Washington Counties; also in Ashtabula County.

1978. Kuhnia eupatorioides L. False Boneset. Lucas, Erie, Clark, Franklin, Gallia, Lawrence.

1979. Lacinaria squarrosa (L.) Hill. Scaly Blazing-star. Lucas, Erie.

1980. Lacinaria cylindrica (Mx.) Ktz. Cylindric Blazing-star. Franklin County.

1981. Lacinaria punctata (Hook.) Ktz. Dotted Blazing-star. A waif in Franklin County.

1982. Lacinaria scariosa (L.) Hill. Large Blazing-star. Erie, Lucas, Fairfield.

1983. Lacinaria spicata (L.) Ktz. Dense Blazing-star. Paulding, Lucas, Wood, Erie, Wyandot, Champaign, Clark, Hocking.

1984. Vernonia noveboracensis (L.) Willd. New York Ironweed. Gallia County.

1985. Vernonia altissima Nutt. (V. maxima Small). Tall Ironweed. General and abundant.

1986. Vernonia fasciculata Mx. Western Ironweed. Erie County.

1987. Vernonia missurica Raf. Missouri Ironweed. Erie County.

1988. Elephantopus carolinianus Willd. Carolina Eilephant's-foot. Scioto, Jackson.

1989. Achillea millefolium L. Common Milfoil. General and abundant.

1990. Anthemis cotula L. Common Dog-fennel. General and abundant. Naturalized from Europe.

1991. Anthemis arvensis L. Field Dog-fennel. Lorain, Lake. From Europe.

1992. Anthemis tinctoria L. Yellow Dog-fennel. Guernsey County. From Europe.

1993. Chrysanthemum leucanthemum L. Oxeye Daisy. General and abundant. Naturalized from Europe.

1994. Chrysanthemum parthenium (L.) Pers. Common Feverfew. Lake, Erie, Montgomery. From Europe.

1995. Chrysanthemum balsamita L. Sweet-Mary. Cuyahoga, Ottawa, Franklin, Madison. Escaped from gardens.

1996. Chrysanthemum indicum L. Chrysanthemum. Escaped in Adams County.

1997. Matricaria inodora L. Scentless Camomile. Lake, Lawrence. From Europe.

1998. Matricaria chamomilla L. German Camomile. Ottawa County. From Europe.

1999. Matricaria matricarioides (Lees.) Port. Rayless Camomile. Stark County. From the Pacific coast.

2000. Tanacetum vulgare L. Common Tansy. General. Naturalized from Europe.

2001. Artemisia caudata Mx. Wild Wormwood. Erie County.

2002. Artemisia annua L. Annual Wormwood. Rather general. Introduced.

2003. Artemisia biennis Willd. Biennial Wormwood. Ashtabula, Cuyahoga, Lucas, Auglaize, Shelby, Wyandot, Franklin.

2004. Artemisia vulgaris L. Common Mugwort. Escaped in Lake and Cuyahoga Counties.

2005. Artemisia pontica L. Roman Wormwood. Champaign, Portage. From Europe.

2006. Artemisia gnaphalodes Nutt. Prairie Cudweed. Lake County. From the West.

2007. Erechtites hieracifolia (L.) Raf. Fireweed. General.

2008. Mesadenia reniformis (Muhl.) Raf. Great Indian-plantain. Clermont, Greene.

2009. Mesadenia atriplicifolia (L.) Raf. Pale Indian-plantain. General.

2010. Mesadenia tuberosa (Nutt.) Britt. Tuberous Indian-plantain. Montgomery, Champaign, Logan.

2011. Synosma suaveolens (L.) Raf. Sweet-scented Indian-plantain. Cuyahoga, Lorain, Stark, Clark, Jackson.

2012. Senecio aureus L. Golden Squaw-weed. General.

2013. Senecio obvatus Muhl. Roundleaf Squaw-weed. Rather general.

2014. Senecio pauperculus Mx. Balsam Squaw-weed. Ottawa County.

2015. Senecio vulgaris L. Common Groundsel. Lake, Lorain, Auglaize. From Europe.

2016. Tussilago farfara L. Coltsfoot. Lake, Cuyahoga. From Europe.

2017. Arctium tomentosum (Lam.) Schk. Woolly Burdock. Erie County. From Europe.

2018. Arctium lappa L. Great Burdock. Lorain, Cuyahoga. From Europe.

2019. Arctium minus Schk. Common Burdock. General and abundant. Naturalized from Europe.

2020. Cirsium lanceolatum (L.) Hill. Spear Thistle. Rather general. From Europe.

2021. Cirsium altissimum (L.) Spreng. Tall Thistle. Rather general.

2022. Cirsium discolor (Muhl.) Spreng. Field Thistle. Western Ohio, as far east as Erie, Huron, Fairfield, and Clermont Counties.

2023. Cirsium virginianum (L.) Mx. Virginia Thistle. Madison County.

2025. Cirsium muticum Mx. Swamp Thistle. General.

2026. Cirsium arvense (L.) Scop. Canada Thistle. General. From Europe.

2027. Onopordon acanthium L. Scotch Thistle. Hamilton, Wayne. From Europe.

2028. Centaurea scabiosa L. Scabious Star-thistle. Lake County. From Europe.

2029. Centaurea jacea L. Brown Star-thistle. Richland County. From Europe.

2030. Centaurea cyanus L. Bachelor's-Button. Montgomery, Franklin, Sandusky. Escaped from gardens.

**Cichoriaceae.** Chicory Family.

2031. Cichorium intybus L. Chicory. Rather general. Introduced from Europe.

2032. Cynthia virginica (L.) Don. Virginia Cynthia. General.

2033. Lapsana communis L. Nipplewort. Franklin, Lake. From Europe.

2034. Arnoseris minima (L.) Dum. Lamb Succory. Lake County. From Europe.

2035. Hypochaeris radicata L. Long-rooted Cat's-ear. Lake, Ashtabula. From Europe.

2036. Apargia nudicaulis (L.) Britt. Rough Hawkbit. Lake County. From Europe.

2037. Tragopogon pratensis L. Yellow Goat's-beard. Lake, Erie, Fulton, Auglaize, Franklin, Miami. From Europe.

2038. Tragopogon porrifolius L. Salsify. Rather general; no specimens from the southeastern third of the state. From Europe.

2039. Sonchus arvensis L. Field Sow-thistle. Lake, Franklin. From Europe.

2040 Sonchus oleraceus L. Common Sow-thistle. General. Naturalized from Europe.

2041. Sonchus asper (L.) Hill. Spiny Sow-thistle. General. Naturalized from Europe.

2042. Lactuca virosa L. Prickly Lettuce. General and abundant. Naturalized from Europe.

2043. Lactuca saligna L. Willow Lettuce. Franklin, Greene, Montgomery. From Europe.

2044. Lactuca hirsuta Muhl. Hairy Lettuce. Tuscarawas, Ross, Union.

2045. Lactuca canadensis L. Tall Lettuce. General.

2046. Lactuca sagittifolia Ell. Arrowleaf Lettuce. Fairfield County.

2047. Lactuca villosa Jacq. Hairy-veined Blue Lettuce. Miami, Montgomery.

2048. Lactuca floridana (L.) Gaertn. Florida Lettuce. From Erie, Franklin, and Ross Counties westward.

2049. Lactuca spicata (Lam.) Hitch. Tall Blue Lettuce. Rather general.

2049a. Lactuca spicata aurea Jennings. Holmes, Defiance, Cuyahoga, Franklin, Athens.

2050. Nabalus altissimus (L.) Hook. Tall Rattlesnake-root. General.

2051. Nabalus albus (L.) Hook. White Rattlesnake-root. General.

2052. Nabalus asper (Mx.) T. & G. Rough Rattlesnake-root. Erie County.

2053. Nabalus racemosus (Mx.) DC. Glaucous Rattlesnake-root. Fulton, Lucas, Ottawa, Erie, Huron, Wyandot, Champaign, Clark.

2054. Nabalus crepidineus (Mx.) DC. Corymbed Rattlesnake-root. Cuyahoga, Champaign, Warren.

2055. Hieracium canadense Mx. Canada Hawkweed. Erie, Cuyahoga.

2056. Hieracium paniculatum L. Panicled Hawkweed. Cuyahoga, Wayne, Richland, Fairfield, Monroe.

2057. Hieracium scabrum Mx. Rough Hawkweed. General.

2058. Hieracium gronovii L. Gronovius' Hawkweed. Fulton, Erie, Franklin, Gallia.

2059. Hieracium marianum Willd. Maryland Hawkweed. No specimens.

2060. Hieracium venosum L. Veined Hawkweed. Eastern Ohio; west to Cuyahoga, Knox, Fairfield, Jackson, and Lawrence Counties.

2061. Hieracium greenii Port. & Britt. Green's Hawkweed. No specimens.

2062. Hieracium pilosella L. Mouse-ear Hawkweed. Lake County. From Europe.

2063. Hieracium aurantiacum L. Orange Hawkweed. Ashtabula, Geauga. From Europe.

2064. Crepis capillaris (L.) Wallr. Smooth Hawksbeard. Lake County. From Europe.

2065. Leontodon taraxacum L. Dandelion. General and very abundant. Naturalized from Europe.

# INDEX TO THE GENERA

The numbers refer to the list numbers at the left of the species names. A few familiar synonyms have been included.

## Bulletins Ohio Biological Survey

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Syrphidae of Ohio by C. L. Metcalf - - - $ .50

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THE OHIO STATE UNIVERSITY BULLETIN
VOLUME XVIII NUMBER 25

# OHIO BIOLOGICAL SURVEY

## BULLETIN 3

# A Botanical Survey of the Sugar Grove Region

BY
ROBERT F. GRIGGS

APRIL, 1914

PUBLISHED BY THE UNIVERSITY AT COLUMBUS, OHIO
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# OHIO BIOLOGICAL SURVEY

HERBERT OSBORN, Director

## OHIO STATE UNIVERSITY IN CO-OPERATION WITH OTHER OHIO COLLEGES AND UNIVERSITIES



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VOLUME 1 BULLETIN 3

# OHIO BIOLOGICAL SURVEY

# A BOTANICAL SURVEY OF THE SUGAR GROVE REGION

By
ROBERT F. GRIGGS

Published by
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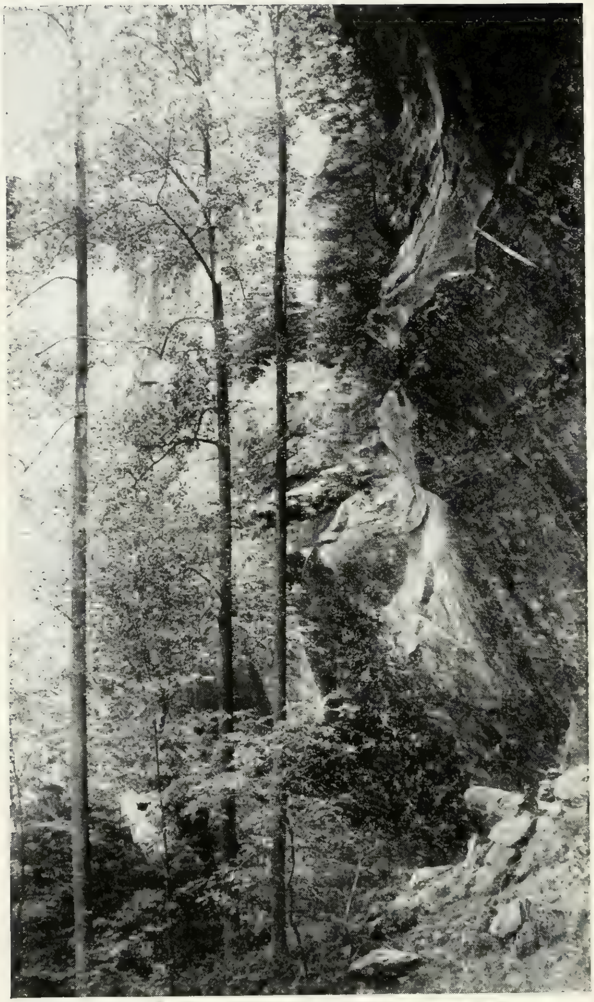

A Liriodendron Cove
(The figure gives the scale.)

—Photo B. B. Fulton.

## CONTENTS

# A BOTANICAL SURVEY OF THE SUGAR GROVE REGION

*By Robert F. Griggs*

## INTRODUCTION

The Sugar Grove region is a narrow strip of country extending from a few miles north of the town of Sugar Grove in Fairfield County, Ohio, in a southerly direction about twenty miles to the valley of Queer Creek near the southern boundary of Hocking County, thus occupying parts of the Lancaster and Laurelville quadrangles as mapped by the U. S. Geological Survey. It has been denominated the Sugar Grove region in this paper not because the various plant societies which distinguish the area reach their climax at Sugar Grove but because that is the only railroad station lying immediately in the region. The country in the vicinity of this village has long been known among the botanists of Ohio as the richest collecting ground in the state with the exception, perhaps, of the region around Sandusky.

In its general relations the flora may be described as an outlier of the great Allegheny mountain flora from which it derives a considerable number of Appalachian plants, like the great Rhododendron, which do not occur elsewhere in Ohio. Besides these plants there are a number of others, like the Lycopodiums, which belong in the Canadian area and come into Ohio from the north, reaching their southern limits, so far as Ohio is concerned, in the present area. In addition to these there is a third element of southern plants such as *Aralia spinosa* which stretch up from Kentucky and Tennessee and reach their northernmost limits in this region. These elements conspire to make the region interesting and to give a very large proportion of the flora that quality of "rarity" which is so dear to the heart of a collector.*

While the Sugar Grove area is rather definitely delimited by the physiographic features about to be described, its principal plant associations are not at all limited to its confines. With slight modification they cover much of the hill country in southeastern Ohio and parts

*These relations have been discussed in detail by the writer in two papers, as follows: Observations on the Geographical Composition of the Sugar Grove Flora. Bull. Torr. Club, 40: 487-499, 1913.
On the Behavior of Some Species on the Edges of their Ranges. ibid 41: 25-49, 1914.

of Pennsylvania and West Virginia as well. The descriptions here given may be applied, therefore, in a general way to the whole of this country, gradually becoming less and less applicable as the distance from Sugar Grove increases and new elements come in to affect the plant covering. This particular area is, however, better adapted to serve as a type of the whole hill country than any other which could be selected within the state of Ohio. The reason for this lies in the greater ruggedness of the country which operates in two ways: first, it is only in a country with high cliffs and deep ravines that the climax associations, both mesophytic and xerophytic, which characterize this territory can develop; and second, the very roughness prevents the agricultural utilization of the country and retards clearing so that here one finds a much larger proportion of unspoiled forest than in any of the country round about.

The causes which led the writer to undertake the present work were: first, interest in collecting over the region itself; second, a belief that an account of the flora would be of service to those who are studying the geographical ranges of the plants of North America; third, a desire to present some account of its ecology which might be useful to phytogeographers in general, such studies of the Alleghenian region being at present rather few and far between; and finally, a recognition of the fact that the portable sawmill is devastating the forest so rapidly that only a few years hence it will be impossible to reconstruct for the service of posterity a picture of the aboriginal condition of the country. Indeed, some of the associations which are here described have been already obliterated and it would be impossible now to duplicate this account.

*Geology and Physiography.* The physiography of the country resembles in a general way that of the hill country found over all of southeastern Ohio and much of West Virginia. It is a rolling upland cut up with numerous deep ravines giving a total relief of from three to four hundred feet.

The shape and boundaries of the Sugar Grove region are determined, except on the north, by the area of maximum outcrop of a heavy sandstone of carboniferous age, the Blackhand conglomerate, which weathers out in high cliffs around every little ravine. That the greatest exposures of sandstone should be limited to so small an area is due principally to the stratigraphic peculiarities of the sandstone which in turn are bound up with the history of its disposition. The various

Fig. 1. A Waterfall in the Hemlock Forest.
Queer Creek.
The man (near the top) gives the scale.

factors are too complex for detailed presentation here, and indeed have not been at all understood by geologists until recently when they have been worked out by Dr. J. E. Hyde for the Geological Survey of Ohio. The writer had the good fortune to have the company of Mr. Hyde on several field trips during which he obtained a considerable amount of information as yet unpublished which has helped him greatly toward an understanding of the geology of the country. Suffice it to say that the heavy sandstone is an old delta with all the peculiarities of cross bedding and local cut and fill usually found in such deposits. Conditions of deposition have also been such as to accentuate and apparently increase the easterly dip of the strata which is general over all of central Ohio. On the eastern edge of the area the sandstone thins out and is carried under cover so rapidly that the character of the country changes greatly within short distances, as for example between Little Rocky Branch (Laurel Township) where the cliffs are so high as to prevent lumbering, and Rocky Branch only a mile away where they are low enough to permit clearing and pasturing. On the opposite edge of the area about four miles to the westward on the other hand, the conglomerate becomes simply a capstone on the tops of the hills, which are further and further apart until the bottom-lands between them are large enough to have made tillage profitable with the consequent destruction of the natural vegetation. The highest cliffs occur in the canyon of Queer Creek near the southern edge of the area where in one place nearly 190 feet of rock are exposed. (fig. 1) South of this point the sandstone thins out rapidly so that the character of the vegetation undergoes a distinct change within a mile or two. On the north occasional outcrops of the sandstone occur far beyond our area but the physiognomy and plant covering of the country are decidedly modified by the presence of a sheet of glacial drift of Wisconsin age, the terminal moraine of which marks the northern boundary of the region.

The area lies therefore wholly below the boundary of the glacial drift, and its soils, except the bottom lands of the largest streams, are entirely residual derived from the decay of the several rocks underlying the land.

The order of succession and approximate thickness of the formations which are exposed within the area are shown in the subjoined table for which I am indebted to Prof. W. C. Morse who has kindly loaned me his field notes containing numerous sections taken from exposures in and adjoining our area, from which I have constructed

the generalized table given. The rocks are all derived from shallow water deposits and like most other such strata vary greatly in thickness and lithogical character within short distances. No single section corresponding to the table could therefore be found, but the data given are sufficiently accurate for the purposes of this paper.

GEOLOGICAL FORMATIONS

| | |
|---|---|
| | *Pottsville.* |
| | 10′ Blue arenaceous shale. |
| | 3″-18″ Coal (Probably the Quakertown Coal, No. 2). Formerly worked at the head of Laurel Run for local consumption. |
| 85′ | 20′ Argillaceous shales and sandstones with some fire clay. |
| | 30′ Massive coarse-grained sandstone (the Sharon), but cemented so loosely as seldom to form surface rock. |
| | 20-30′ Thin-bedded sandstones with some impure fire clay and coal blossom. |
| | *Logan formation.* |
| 45′ | Thin-bedded sandstones with argillaceous or arenaceous shale partings, some strata of impure nodular limestone. |
| | *Black Hand Conglomerate.* (Upper portion of Cuyahoga formation), |
| 200′ | A single conglomeritic sandstone or several, usually two, heavy sandstones separated by intervals of argillaceous shale. |
| | *Cuyahoga formation* (proper) |
| 500′ | Sandstones, mostly thin-bedded, and shales. The top of the formation is exposed in a few places in our area. |

Except for the Black Hand the rocks are seldom exposed except in the bottoms of the ravines and in artificial excavations such as roadside ditches. Their physiographic features therefore require no special mention, but the peculiarities of the weathering of the Black Hand have a large effect on the physiography and the vegetation of the country. When first quarried this stone is very friable, but on exposure it becomes hard and durable. Thus it often happens that the exposed top of a cliff becomes much harder than the protected portion which weathers away more rapidly, forming an overhang. The "caves," as they are popularly called, so formed are very numerous and some of them are very extensive, when the method of their formation is considered. The most interesting are favorite places for picnics and a few of them have acquired more than a local reputation. Ash Cave is the largest, being nearly 700 feet long with an overhang of about 60 feet and a height at the waterfall of 84 feet. Old Man's

Cave (fig. 22) is not so large but is higher, more beautiful, and more interesting to a botanist. In Cantwell Cliffs the cave is almost hemispherical with a narrow ledge half way up where one finds acoustic properties that are little short of marvelous. More celebrated than any of the others and more remarkable from a physiographic point of

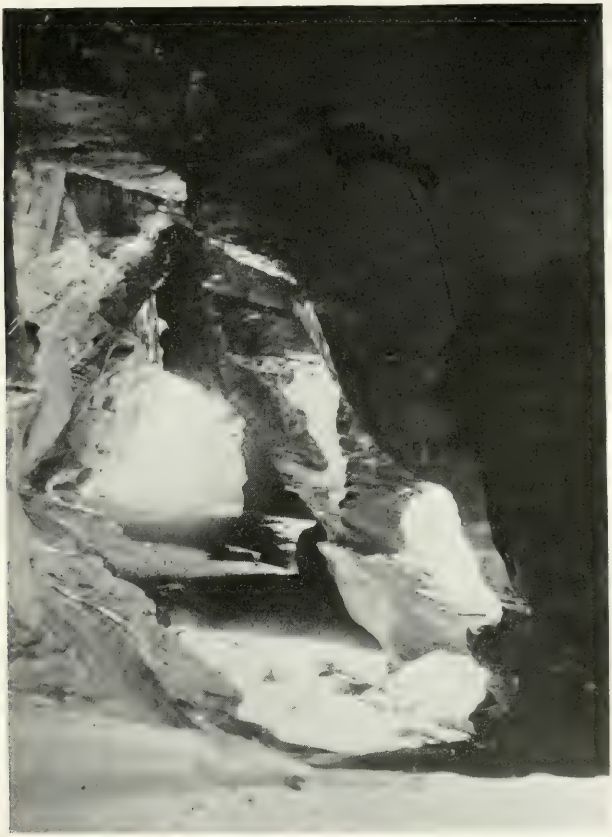

Fig. 2. The Interior of the "Rock House."

view is the Rock House (fig. 2). This was formed by the accentuation of processes often seen in lesser degree throughout the region. In this case the rock crumbled back along the moisture-laden joint planes till the soft interior was exposed and in turn crumbled along a joint plane parallel to the face of the cliff until there has been formed a corridor about 200 feet long which runs along behind a series of six

columns, the remains of the original face of the cliff, which support the vaulted roof.

Some of these caves afford exceedingly moist habitats with water dripping from the rock in abundance and an atmosphere laden with moisture to near the point of saturation. Others exposed to the sun are extremely dry, being sheltered from all rainfall and kept thoroly dried out by daily insolation.

*Soil.* No detailed study of the soils of the region has ever been undertaken, but it may be desirable to indicate briefly the general character of the principal soils met with in the area. Except for the rich bottom land of the Hocking River, all of the soils, bottoms as well as uplands, are derived from the disintegration of the sandstone rocks of the area, and are therefore deficient in basic materials. There is much variation in the physical character of the various soils depending on the relative amounts of arenacious and argillaceous constituents present. In the deep ravines under the cliffs the soil often consists of almost pure sand. Such soils are so loose and porous that the abundant organic remains they contain do not humify but are rapidly and completely oxidized without enriching the soil to any great extent. The soils derived from the formations above the Black Hand, on the contrary, have a considerable amount of clayey material which gives them a decidedly sticky consistency when wet, but they dry easily, and except when very wet would be classed as light rather than heavy. Between these two extremes there is naturally every intergradation, depending on the degree to which constituents from the two principal rocks have entered into the soil of any given situation. While there are other soils more or less widely distributed over the area these two types with their intergradations cover so large a proportion of it that they may properly be said to constitute its soil.

The soil must be classed as poor from an agricultural point of view. The bottom lands, except for the rich Hocking bottom, are not very generally utilized. They are mostly too narrow for successful cultivation and their soils are generally so light and sandy as to be difficult to manage profitably. On the uplands wheat is the staple crop but it is difficult to secure a proper rotation since corn and clover do not thrive on account of the prevalence of soil acidity. The greater part of the land is so subject to wash, either from floods or from surface run-off, as to be continually menaced whenever the sod is broken up for cultivation.

*Climatology.* Those features of the meteorology which go to make up the climate have been compiled and published by J. Warren Smith[1] in a report covering the state of Ohio as a whole and earlier as Section 71, South-central Ohio (1910) in the general summary of climatological data for the United States. It is from the introductory matter of the latter report, as more specifically describing conditions in our area than the general bulletin, that the direct quotations given below were taken.

No records have been taken within the area itself but the data given for surrounding towns, since they are reasonably concordant, give, it is believed, an accurate idea of the larger climatic features affecting vegetation. The stations selected are: Lancaster, about five miles north of the area with a record twelve years in length, from 1896 to 1908; Logan, about 10 miles east of the area, with records for sixteen years, from 1884 to 1900; Circleville, about 15 miles west of the area, with records of twenty years, from 1888 to 1908; McArthur, about twenty miles to the south, with records for the five years from 1894 to 1899, and parts of three additional years; while the observations of the regular Weather Bureau station at Columbus, thirty-five miles northwest, with records extending back to 1878, have been used for comparison.

The monthly mean temperatures in degrees Farenheit of those stations whose records are available are as follows:

MONTHLY MEAN TEMPERATURES

| | Yrs. of Record | January | February | March | April | May | June | July | August | September | October | November | December | Annual | Growing Season Ap. to S. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lancaster ... | 13 | 30.2 | 28.2 | 42.0 | 50.5 | 62.3 | 69.1 | 74.0 | 71.7 | 66.5 | 54.0 | 42.2 | 32.3 | 51.9 | 65.7 |
| Circleville ... | 14 | 30.2 | 28.1 | 43 3 | 51.8 | 63.2 | 70.7 | 75.3 | 73.3 | 68.0 | 54.9 | 42.4 | 32.7 | 52.7 | 67.0 |
| Columbus ... | 31 | 28.9 | 30.1 | 39.6 | 51.1 | 62.5 | 71.0 | 75.2 | 72.7 | 66.9 | 54.7 | 41.8 | 32.7 | 52.2 | 66.6 |

The highest and lowest temperatures ever recorded are 102 and -21° at Circleville, 99° and -21° at Lancaster, 104° and -20° at Columbus. The highest temperature is usually reached in July, but August is nearly as hot. The lowest temperatures are sometimes reached in

1. Smith, J. Warren. The Climate of Ohio. Bull. O. Ag. Ex. Sta. 235:185-209, 1912.

January and sometimes in February. The data do not include, however, the extremely hot summer of 1911, nor the exceptionally cold winter of 1911-12. The extreme temperatures recorded for the middle section of the state, 108°and -34°, will perhaps give a better idea of what may be expected for the absolute extremes in our area. These are of course important because of their destructive effect on vegetation which would tend to control the southern limits of certain species and the northern limits of others and so react on the composition of the flora.

The average date of the last killing frost in spring is April 30. of the first killing frost in the autumn October 2. The average growing season is therefore about 155 days in length. But the latest killing frost reported was on May 30, and the earliest in autumn about September 15, giving a minimum growing season, if both late and early frosts should occur in the same year, of only 110 days. But the frost data have not been taken for a long enough period at any of the stations under consideration to give reliable data as to possibilities in this direction. "On June 5, 1859, a killing frost occurred in the central and northern part of this section [i. e. Sec. 71] that is still known as the great June frost."

"*Precipitation* is quite uniform over the whole of the section [in which our area is located] and averages about 38 inches (95 cm.) per year. At North Lewisburg in Champaign County the smallest annual rainfall in a period covering 56 years was 23 inches (57.5 cm.) in 1872, and the greatest 58 inches (145 cm.) in 1852," while at Cincinnati in a record from 1835 to 1908 inclusive, the least was 17.99 inches (42.5 cm.) in 1901 and the greatest 65.18 inches (163 cm.) in 1847. "The distribution of the rainfall is fairly uniform, as will be seen from the table given herewith." "In general there is the greatest average rainfall in June and July, and the least in October. There are very few months with less than an appreciable amount of precipitation in all parts of the section, and monthly falls of over 10 inches (25 cm.) are not very frequent. The greatest monthly fall reported at any of the stations under consideration is 15.90 inches (40 cm.) at North Lewisburg in September, 1866," while at Carthegena, Mercer County, 17.33 inches (43 cm.) fell in June, 1877. Although these stations are at considerable distances from the area under consideration, their records will give a fair idea of the maximum precipitation to which its vegetation would be subjected in a long series of years. This extreme maximum is of

importance because of the destructive effects of the floods, which would fix the boundaries of the flood-plain associations subject to inundation and prevent permanent encroachment upon these associations by the plants of higher ground which could not endure the flood.

AVERAGE MONTHLY RAINFALL (INCHES)

| | Yrs. of Record | January | February | March | April | May | June | July | August | September | October | November | December | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lancaster .......... | 12 | 2.90 | 2.67 | 4.73 | 2.97 | 4.31 | 4.64 | 4.58 | 2.88 | 2.13 | 1.93 | 2.73 | 3.15 | 39.62 |
| Logan ............. | 16 | 3.54 | 3.92 | 3.27 | 2.86 | 3.51 | 4.31 | 4.19 | 3.63 | 2.94 | 2.31 | 3.38 | 2.64 | 40.50 |
| Circleville .......... | 20 | 2.69 | 2.67 | 3.61 | 2.73 | 3.60 | 4.09 | 3.94 | 3.14 | 2.28 | 2.17 | 2.64 | 2.40 | 35.96 |
| McArthur .......... | 5 | 3.12 | 3.55 | 3.69 | 2.49 | 3.69 | 3.56 | 4.31 | 3.01 | 2.45 | 1.72 | 2.93 | 2.91 | 37.43 |
| Columbus .......... | 30 | 2.97 | 3.01 | 3.49 | 2.84 | 3.80 | 3.41 | 3.65 | 3.21 | 2.41 | 2.32 | 2.91 | 2.66 | 36.68 |

The average snowfall is very close to 25 inches (62.5 cm.). The configuration of the land is such that the snow is generally blown or melted off the uplands, leaving them bare and exposed for the most of the winter. The depth of the annual snowfall is an insignificant factor in such situations, but in the deep ravines the drifts accumulate and keep them cold and wet well into the spring, affording thereby suitable habitats for the many northern plants, which here reach their southern limits. Single snowfalls exceeding 8 inches (20 cm.) are not common, but there is a record of 30 inches (76 cm.) at Lancaster during April, 1901. At Columbus 13.5 inches (39 cm.) is the greatest amount of snow ever reported upon the ground at one time. The greatest annual snowfall of record is 67.8 inches (170 cm.) in the winter of 1909-10, while the smallest is 8.5 inches (21 cm.) in the winter of 1896-7. Snowfall is usually confined to the months from November to April, but "appreciable depths of snow sometimes occur in May and October."

"The average number of rainy days is 106. The average number of clear days is from 125 to 150, and the average number of cloudy days is about the same. At Columbus the average annual sunshine is 54% of the possible amount; the average number of clear days is 103, partly

cloudy 131, and cloudy 131. The average number of days with thunderstorms at Columbus is 33."

The prevailing winds at Columbus are southwest and the average movement of air is eight miles per hour. Tornadoes are rare, but storms violent enough to destroy many trees are of periodical occurrence. The records of the Weather Bureau show that during the years 1892-1901, when the observing station was located in a comparatively low building, there averaged 3.4 days per annum with winds reaching

Fig. 3. Over the Upland Between Big Pine Creek and Queer Creek. Timber remains only in the ravines.

or exceeding 40 miles per hour. But from 1903 to 1911, after the observatory was moved into a "skyscraper," the average number of days with gales rose to 26.5. The absolute maximum is 70 miles per hour on March 15, 1908.

The mean relative humidity at Columbus is as follows:

| | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 a. m. | 84 | 82 | 80 | 74 | 75 | 77 | 76 | 79 | 80 | 81 | 82 | 73 |
| 7 p. m. | 77 | 74 | 69 | 61 | 61 | 63 | 59 | 61 | 62 | 64 | 70 | 76 |

On the longest days of the year there are about 15 hours of sunshine from sunrise to sunset.

## ECOLOGY

As in all dissected countries the area is to be divided primarily into lowland and upland (figs. 3, 4 and 5). These two divisions form the basis of the human society which occupies the territory. There are lowland farmers and upland farmers; each community has its own set of roads and travel tends to stay down if following a valley road and to

Fig. 4. "Kunkle's Hollow."
Upland and Lowland Forests.
Oak forest on the more sheltered west hillside (left) and pine forest on the more exposed east clifftop (right). Liriodendron forest in the ravine.

keep up if on a ridge road. The plant covering likewise is to be divided primarily into lowland and upland forests, each of which is naturally sub-divided into its component associations. In the case of both lowland and upland forests, it will be most convenient to begin the description with the extreme types and proceed to the less extreme, finally describing the intermediate associations which mark the transition from lowland to upland.

## THE BOTTOM LANDS

Of all the problems that confront one who is attempting to find out the aboriginal condition of this country, none is so difficult as the reconstruction of the vegetation of the bottom-lands along the large streams. There is not a vestige left to suggest the original condition

of the Hocking bottom between Lancaster and Logan except the swamps described below and a few large trees standing in the fields into which it has been converted (fig. 6). Many of these, however, have either come up from seed since the forest was cut off or were very young at that time, for they show no traces of ever having been crowded by near neighbors. One of them, a sugar maple (*Acer. saccharum*), known as "The Queen of the Valley (figs. 6 and 7), is the most perfect specimen of a round-topped shade tree known to the writer. Whether this bottom-land was originally covered with associations similar to those of rivers in other parts of the state or whether it partook of the features of the mixed forest of the "coves" cannot now be determined. Farmers who with their parents before them have always lived in the valley know nothing of the time when the land was generally clothed with forest. The last

Fig. 5. The Hocking Valley at Sugar Grove.
The hillsides still forested and largely in their natural condition, lowland and upland both cleared and cultivated.

vestige of the forest, a little patch of only a few acres, was cleared away, so the writer is informed, about fifteen years ago. It is said to have contained some very large sycamore trees, with an admixture of some other species.

Figs. 6 and 7. The "Queen of the Valley."
A Sugar Maple in the Hocking Bottomland.
—Photo by J. E. Hyde.

Fig. 8. Blephariglottis paramoena Growing in a Weedy Bottomland with Mixed Vegetation in which Agrimonia is Prominent.

Even when themselves undisturbed, no other associations show so quickly the effects of the changes in the land around them as the bottom-lands. The periodical freshets are very efficient carriers of seeds from place to place. It is obvious that any change in the vegetation at one place will change the character of the seeds carried down stream into other unchanged societies. In the original condition of the country the seeds thus brought in by the freshets would represent largely

species already present, and the ensuing struggle between the seedlings, whatever might be its result, would not affect the composition of the association. If the new plants which appear on clearing had to struggle simply against the established association, they might not be able to gain a foothold. But with the very changes which supply different kinds of seeds there comes an unsettlement of the societies already in possession. The floods become much more destructive and uproot large patches of the original vegetation. In this way a place is prepared already cleared for the invaders and they are no longer handicapped, but compete at an advantage over the original inhabitants of the soil. This condition is noticeable in the brooks as well as the rivers in an area like the present, where the uplands are cleared down to the fall line and used for agricultural purposes, while the ravines are left in timber.

### THE BOTTOM LAND SWAMP

Perhaps the clearest indication of the original condition of the Hocking bottom land, except for the very bank of the stream, is (or was, prior to 1912, when it was lumbered) given by a small swamp in the N. E. 1/4 of section 4, Berne Twp., on the west side of the river. This was originally covered with very large trees, six feet or more in diameter, the stumps of which are not yet entirely decayed. The second growth which has replaced this forest seems, fortunately for the purpose in hand, to be a fairly natural association, altho the herbage in all but the wettest parts is so modified by pasturing that it can give no idea of the original association.

The larger part of the area may be described as a maple swamp in which Acer rubrum covers the ground in places to the exclusion of all other species, both herbaceous and woody. Beneath the maples the ground is bare and muddy or covered with shallow puddles. In places where the maples are not so thick, a more varied flora appears, the principal components of which are:

| | |
|---|---|
| *Alnus rugosa* | *Benzoin benzoin* |
| *Ulmus americana* | *Gleditsia tricanthos* |
| *Cephalanthus occidentalis* | *Salix nigra* |

Where the land is a little dryer, numerous other trees appear; among these the following are abundant enough to deserve mention:

| | |
|---|---|
| *Quercus palustris* | *Quercus imbricaria* |
| *Malus glaucescens* | *Carpinus caroliniana* |
| *Juglans nigra* | *Juglans cinerea* |
| *Fraxinus pennsylvanica* | *Fraxinus americana* |
| *Quercus bicolor* | *Prunus virginiana (serotina)* |

In other places, permanently covered by the water coming from several springs at the base of the hillside, the ground is bare of trees and a very interesting association of shade-enduring swamp herbs has

Fig. 9. Lizard's Tail (Saururus) in the Bottomland Swamp.

developed. In the spring this association is dominated by CALTHA PALUSTRIS and SPATHEMA FOETIDA with, as secondary species:

| | |
|---|---|
| *Senecio aureus* | *Cardamine rhomboidea* |
| *Ranunculus septentrionalis* | *Ranunculus sceleratus* |

During the summer, SAURURUS CERNUUS (fig. 9) dominates the association, while in the autumn its place is taken by POLYGONUM ARIFOLIUM, with which are a large number of species in greater or less abundance, including the following:

| | |
|---|---|
| *Chrysosplenium americanum* | *Alisma subcordatum* |
| *Carex sp.* | *Penthorum sedoides* |
| *Isnardia palustris* | *Bidens connata* |
| *Bidens aristata* | *Bidens cernua* |
| *Lobelia cardinalis* | *Lobelia syphilitica* |
| *Lillium canadense* | *Solidago patula* |
| *Phlox maculata* | *Blephariglottis lacera* |

On one side this swamp is contiguous with a wooded hillside bearing the usual forest of the coves. At the meeting place the two associations are sharply demarked by the character of the soil. There is no sign of the encroachment of one association on the other and no tension zone between them.

### THE BIRCH BOTTOM LAND

One often reads accounts of the settlement of the country by the pioneers of bottom-lands covered with birch instead of willow, but so

Fig. 10. The Birch Bottomland on Queer Creek.
*Betula lutea* in almost pure stand.

far as Ohio is concerned, these have almost completely vanished. Birch bottoms, however, must originally have abounded along the streams in

this region. But now all of the flood-plains not under cultivation are occupied by the usual mixed association of deciduous trees, dominated by the willows (principally *Salix nigra*) and the sycamore, together with coarse weeds, such as *Ambrosia trifida*, and various composites. Although birches are common along the streams from Laurel Run southward, it is only in the canyon of Queer Creek that anything like an unspoiled birch bottom can be found, and even here the undisturbed association remains in only a very limited area—less than an acre all told—and there is a considerable admixture of species which were not present in the association in primeval times.

The land is flat, with numerous shallow pools furnishing breeding places for salamanders, etc. The soil is almost pure sand, with little humus, most of the organic matter being in the form of undecayed particles of wood.

The two birches, BETULA LUTEA and *B. lenta*, are both abundant, the former occupying nearly one-half of the area (fig. 10), while the river birch, *B. nigra*, occurs on the edge overhanging the stream. Together with these are scattered individuals of hemlock (*Tsuga*) and beech, (*Fagus*). Along the water's edge, where the light is stronger, are some other trees which are probably intruders since the days of floods. These are: Ash (*Fraxinus americana*), sycamore (*Platanus*), basswood (*Tilia*), butternut (*Juglans cinerea*), blue beech (*Carpinus*), and red maple (*Acer rubrum*). The underbrush is made up of yew (*Taxus*), with some witch hazel (*Hammemelis*) and spice bush (*Benzoin*).

The real character of the herbage is very difficult to determine, for there is an admixture of all sorts of plants from almost all possible associations, especially weeds whose seeds are continually brought in by the stream. One cannot be sure which to eliminate as intruders, since there are no other areas to use for comparison. The following list, however, seems to include most of the characteristic plants:

| | |
|---|---|
| *Circaea lutetiana* | *Circaea alpina* |
| *Dryopteris spinulosum* | *Dryopteris marginale* |
| *Lycopodium lucidulum* | *Cathrinea sp.* |

To these must be added the Virginia creeper (*Parthenocissus*) which is common but so small that it must be classed as an herb, seldom rising off the ground. This plant might be described as waiting round for an opportunity to assert itself. The weak light that reaches it is

just enough to support it, but does not permit any but the slowest growth. But whenever a break in the forest lets in the light, it is ready to spring up luxuriantly and cover the open places.

It will be observed that this herbage is very similar to that of the hemlock forest (see p. 269) which covers the hillside above the flat, and it is clear that the two associations are closely akin. The one passes into the other abruptly as the level land gives way to the hillside, the place of *Betula lutea* being taken by the hemlock, while the yew, the ferns and the lycopod become more abundant.

The one factor which more than any other appears to be responsible for the development of this association is the absence of light. This is pre-eminently an association of sciophytes. On both sides it is hemmed in by lofty cliffs, which greatly reduce the light reaching the bottom. The shade is so dense that of the many weeds which one finds starting up in the spring all but a few stunted individuals have died off for lack of light by mid-summer. A shade-enduring community is, however, of necessity slow growing, and when once the shade is removed, this association has little chance of reproducing itself against the competition of the aggressive, sun-loving plants which form the common bottom-land association throughout the Central States.

### THE RIVER BANK ASSOCIATION

While the vegetation on the banks of the larger streams is a heterogeneous mixture of all sorts of elements, especially annual weeds, the banks of Queer Creek are covered in places with an association of geophilous perennial herbs which is close to the natural condition. This may be observed, perhaps to greatest advantage, on the banks of the basin below The Falls at the head of "The Gulf."

It develops on banks which are too frequently overflowed to permit the growth of trees or bushes. Consequently it is well illuminated The soil is loose, almost pure sand, which is held in place by the underground parts of the vegetation.

The dominant plant is PANICUM LATIFOLIUM, with *Carex prasina* and *Senecio aureus* in considerable abundance, while *Phlox maculata*, *Rudbeckia laciniata* and *Lobelia syphilitica* are usually present and, by reason of their flowers, conspicuous. Where the association is somewhat shaded, *Lobelia cardinalis* appears in abundance, becoming the fascies in August.

As normally developed this association is always confined to a narrow strip a meter or two wide bordering on the water. But it is one of the associations which have become greatly extended since the clearing of the country. In the cleared lands, however, it does not develop in its purity, but becomes a meadow covered with *Panicum latifolium*, together with various sedges, rushes, and other common meadow and pasture plants.

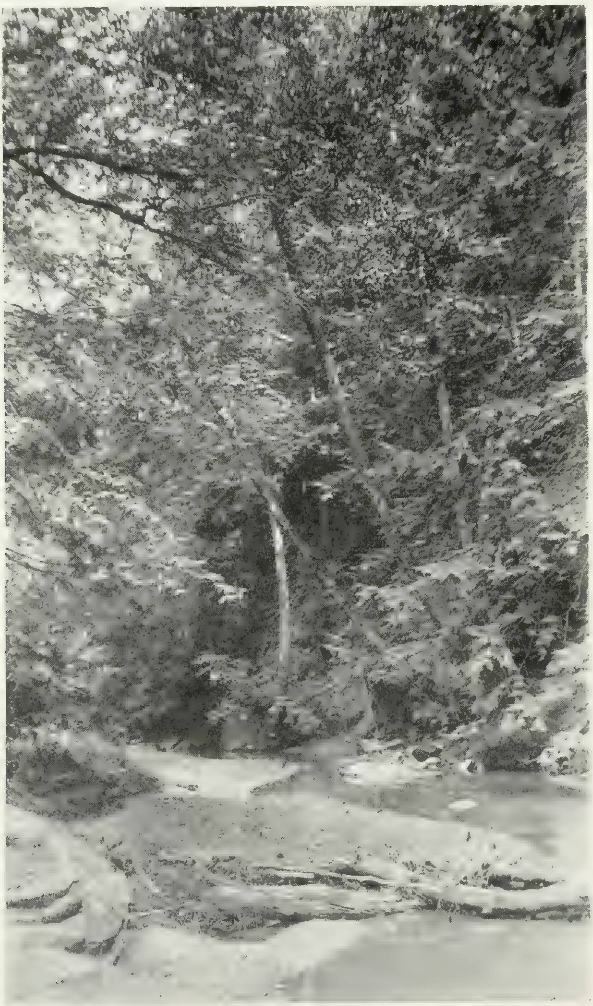

Fig. 11. The Hemlock Forest on Queer Creek.

## THE FORESTS

### A. The Lowland Forest

*The Hemlock Forest.* The deepest forest in the region is that formed by the hemlock, which is most luxuriant on the sides and bottoms of the deeper ravines south of Clear Creek (fig. 11). Tho individual hemlock trees are common enough all through the area, the pure hemlock forest is not found north of that stream.

In its extreme form the hemlock forest is an unmixed association of hemlocks, no other vascular plant but Tsuga canadensis being present. More often, however, *Betula lenta* is associated with Tsuga and the ground is not bare but occupied by the yew (*Taxus*), and herbage consisting of:

| | |
|---|---|
| *Dryopteris spinulosum* | *Mitchella repens* |
| *Lycopodium lucidulum* | *Tiarella cordifolia* |

There are also usually numerous seedlings of soft maple (*Acer rubrum*). In almost all the forests, indeed, this species furnishes a majority of the tree seedlings, but nowhere except in the bottom-land maple swamp do the full grown trees become at all abundant. While maple seedlings seem to be better able to endure deep shading than those of other forest trees, they do not seem to be able to compete with them when, by a break in the forest canopy, a place is made for a new tree. In the abundant illumination supplied by the displacement of one of the original forest trees, other species are apparently able to grow enough more rapidly to overcome the lead of the maple seedlings already present and to succeed to the vacant place.

Where the association begins to give way to the mixed deciduous forest which usually adjoins it, a few beeches and maples usually come in, and both underbrush and herbage become more abundant and varied, the former consisting of:

| | |
|---|---|
| *Parthenocissis quinquefolia* | *Hamamelis virginiana* |
| *Viburnum acerifolium* | *Cornus alternifolia* |

While in the herbage appear:

| | |
|---|---|
| *Viola blanda* | *Medeola virginica* |
| *Dryopteris spinulosum* | *Unifolium canadense* |
| *Peramium pubescens* | |

And in less typical portions are found:

| | |
|---|---|
| *Dryopteris marginalis* | *Circaea alpina* |
| *Hepatica acuta* | *Carex plantaginea* |
| *Actea alba* | *Ranunculus recurvatus* |
| *Arisaema triphyllum* | *Asarum sp.* |

The frequent association of the sweet birch (*B. lenta*) with the hemlock seems to be due to the similarities in their root systems. The seedlings do not develop a tap root, but form a much-branched system of fibrous roots, which spread out freely near the surface, never attaining any great depth. They are therefore especially suited to rocky situations in which penetration is difficult or impossible, and they are

Fig. 12. A Cascade in the Hemlock Forest.

limited to substrata furnishing a constant supply of water near the surface. Very few soils, however, can maintain such a condition except when bathed in a heavily moisture-laden atmosphere. In such humid habitats both species do well regardless of the substrata, growing almost everywhere and showing a strong tendency to become epiphytes. But

in this region almost all of the seedlings that start as epiphytes as, for example, in the mossy covering of a fallen log, soon exhaust their moisture supply and succumb to drouth; but occasionally one gets a root down into the ground and continues to grow. On Queer Creek,

Fig. 13. The Bottom of Kunkle's Hollow, Formerly Occupied by the Hemlock Forest.

one such birch sapling was noticed, in this case *Betula lutea*, which had started on a hemlock stump nearly a meter from the ground. It had reached a diameter of nearly a decimeter, was supported on "stilts"

formed by its strong roots, and gave every evidence that it would continue to grow and become a large tree.

On account of the character of the root system of the plant, the hemlock forest has small opportunity to reproduce itself when once it is cut off. The removal of the trees changes the ravines from the coolest to the hottest parts of the country and the shallow-rooted seedlings have small chance of survival. It is fortunate indeed, therefore, from a practical point of view, that the commercial value of hemlock timber is less than that of the trees with which reforestation may occur.

The cause of the non-occurrence of the hemlock forest in the northern section of our area is apparently due to a slight difference in physiography. On account of the greater thickness of the sandstone to the southward, the valleys are younger in a physiographic sense; the canyon walls are higher and more nearly continuous along the larger streams, and in the smaller ravines the waterfalls are higher and more numerous than further north. In these deeper ravines conditions are more extremely mesophytic, if the term be permitted, than elsewhere. That is to say, conditions here more nearly resemble those in the most typical of all mesophytic formations, the tropical rain-forest, than anywhere else in our area. The atmosphere is kept continually near the point of saturation, while the shade in the deepest portions of the forest is so intense as to absolutely prohibit the growth of plants other than the forest trees themselves.

When the valleys have become somewhat older and developed sufficiently to have a mantle of soil on the bottom and up the sides, the hemlock sooner or later gives way to the Liriodendron forest. Under natural conditions this may not happen for thousands of years as, for instance, in the Queer Creek canyon, where a typical hemlock forest occupies a deep bottom land soil and probably would continue to do so for a long time to come. But even here the bank of the stream is occupied by various deciduous trees which would gradually but certainly beat back the ancient hemlock forest. In the typical Liriodendron forest, as seen further north, the hemlocks and birches are limited to the rocks forming the upper rims of the ravines, while the whole of the soil-covered valley is dominated by the deciduous forest about to be discussed.

*The Liriodendron Forest.* The Liriodendron forest flourishes in conditions but little different from the hemlock forest which it is gradually replacing. Its most typical development occurs in the characteristic

"Coves" which abound throughout the area. A cove (frontispiece), in the lumberman's vernacular, is a short, steep ravine, surrounded by high hills or margined with cliffs, within which the timber, though brittle, is unusually tall, straight, and free from knots and wind checks. The reason for this character of the timber is, of course, the struggle for sunlight in which the trees on the bottom are placed at a disadvantage as compared with their neighbors higher up on the slope. The conditions for vegetation in these coves are highly favorable in respect to both climatic and edaphic factors. The soil is for the most part a loose, sandy loam, with considerable humus on the surface, but more sandy below, in places becoming nothing but sand, which is dug by the farmers and serves very well for domestic uses.

In these coves there develops a luxuriant forest, richer in species than any other association in our area. Like the hemlock forest, the Liriodendron forest has suffered severely from the lumberman until it is now difficult to find a good specimen for study. One of the best is the "Crystal Springs" ravine at Sugar Grove, which has been used as a summer resort for twenty years, during which time the timber has not been disturbed, although the underbrush and herbage have been more or less modified by the activities of picnickers and botanists. Another good cove is located about a half a mile north of Sugar Grove, near the pumping station in section 4, Berne Twp. This one was lumbered a number of years ago, but has since lain undisturbed, and in its herbage probably represents more normal conditions than the other. Unfortunately it was swept by a fire during the winter of 1909-10, which damaged it so much that it is no longer interesting to an ecologist. The picture of the cove forest here drawn is largely a composite of the conditions in these two ravines.

The forest of these "coves" is so diversified that often no one tree can be designated as the fascies, but all in all there is little question but that the tulip tree (LIRIODENDRON TULIPIFERA) is most characteristic. Following it, roughly, in the order of abundance, are:

*Castanea dentata* (especially on the higher slopes)
*Tsuga canadensis* (also most abundant on the higher slopes)

*Juglans cinerea*
*Fagus grandifolia*
*Acer rubrum*
*Nyssa sylvatica*
*Hicoria ovata*
*Quercus alba*
*Quercus velutina*
*Betula lenta* (on the steeper slopes)
*Morus rubra*

The underbrush in places, especially on densely shaded slopes with a northern exposure, consists of thickets of *Rhododendron maximum*

(fig. 14), almost without intermixture of other species, either frutescent or herbaceous. In general, however, a variety of smaller trees

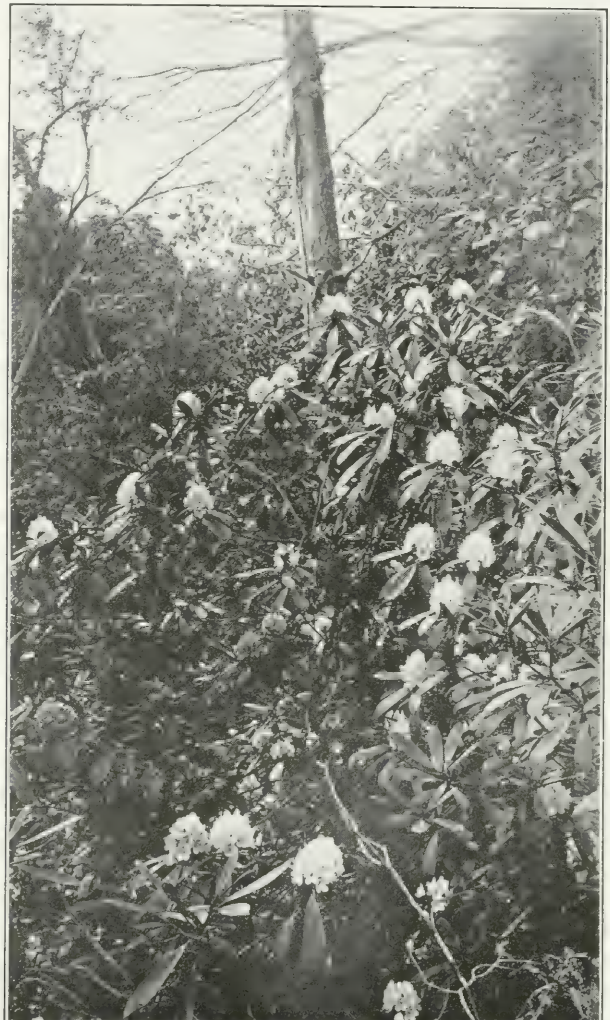

Fig. 14. The Rhododendron at Sugar Grove.
—Photo by J. E. Hyde.

and shrubs grow beneath the forest canopy. These are:

| | |
|---|---|
| *Hammamelis virginiana* | *Cynoxylon (Cornus) florida* |
| *Cornus alternifolia* | *Azalea lutea* |
| *Hydrangea arborescens* | *Viburnum acerifolium* |

Together with these are young individuals of the forest trees and stragglers from other associations which, though frequently abundant here, especially in places where the forest is younger, are gradually suppressed by overshading. The most abundant of these are *Sassafras*, *Oxydendron*, *Kalmia*, and *Quercus prinus*.

As under-shrubs and semi-lianes are:

| | |
|---|---|
| *Smilax rotundifolia* | *Smilax echirrata* |
| *Clematis virginiana* | *Passiflora lutea* |
| *Parthenocirsus quinquefolia* | *Rhus toxicodendron* |

The last two in this forest, as in the birch bottom land, are strictly ground trailers, and though always common, are never luxuriant until a windfall or other accident lets in the light, when they shoot up with great rapidity into their well-known full liane form.

The herbage is composed of a large number of species belonging to several guilds. In the most shaded woods, in situations where at the same time leaf-fall is not too abundant, herbs with evergreen or hibernating leaves are abundant and conspicuous, especially during the winter, when other herbs are absent. These include:

| | |
|---|---|
| *Carex plantaginea* | *Hepatica acutiloba* |
| *Polysticum achrosticoides* | *Dryopteris marginale* |
| *Dryopteris spinulosum* | *Botrychium obliquum* |
| *Pyrola elliptica* | *Lycopodium lucidulum* |
| *Tiarella cordifolia* (in the southern section) | *Asplenium platyneuron* |

When not too much shaded and especially in younger second growth there is a rich development of vernal herbs typically geophilous and with showy flowers, such as:

| | |
|---|---|
| *Trillium grandiflorum* | *Bicuculla canadensis* |
| *Bicuccula cucculata* | *Erythronium americanum* |
| *Podophyllum peltatum* | *Arisaema triphyllum* |
| *Juncoides carolinae* | *Viola pubescens* |
| *Viola blanda* | *Viola rostrata* |
| *Viola palmata* | *Syndesmon thalictroides* |
| *Viola canadensis* | *Botrychium virginianum* |
| *Galeorchis spectabilis* | *Vagnera racemosa* |
| *Aralia nudicaulis* | *Geranium maculatum* |
| *Thalictrum dioicum* | *Dentaria laciniata* |
| *Dentaria heterophylla* (in southern section only) | *Ranunculus recurvatus* |

Later in the summer the places of these are taken by another set of plants, including:

| | |
|---|---|
| *Cimucifuga racemosa* (fig. 15) | *Circaea lutetiana* |
| *Phyrma leptostachya* | *Aster divaricatus* |
| *Adicea pumila* | *Aristolochia serpentaria* |
| *Sanicula canadensis* | *Medeola virginica* |

Fig. 15. Black Cohosh (Cimucifuga in the Liriodendron Forest.

Chlorophylll-less phanogams are represented in abundance by the parasitic Squaw-root, *Conophyllis Americana*, and Beech Drops, *Leptamium Virginiana*, and the saprophytic *Monotropa uniflora* and *Hypopytis Americana*.

These Liriodendron "coves" once covered a large proportion of the northern section of our area. Below Clear Creek they are, and probably always were, scarce. Their place is taken almost everywhere by the hemlock forest which, as has been stated, does not extend north of that point.

## B. The Upland Forest

The succession of associations in the upland forest is best seen by ascending the point of one of the long, narrow ridges between the ravines and walking back from the edge of the cliff through the pine woods into the oak forest and around to the head of the ravine where the upland merges with the lowland.

*The Cliff Top.* At the tops of the cliffs there is a narrow strip of what may be termed a miniature lichen tundra (fig. 16), since it possesses all of the essential features of the northern tundra. The substratum is extremely acid to litmus paper. It is exposed to the extreme

action of the wind and to the greatest extremes of temperature, together with the most sudden changes which are possible within the limits set up by the climate of the region. The flora is of the sort that has generally passed as xerophytic, but in reality it may not be so much xerophytic as oxyphytic. It bears little resemblance to the truly xerophytic flora of desert regions.

Fig. 16. The Miniature Tundra at the Edge of the Pine Forest.

The vegetation of the cliff tops develops into zones similar to those found around ponds, but in this case the zones depend on the depth of the soil and the exposure. The front rock is nearly bare, but supports a few foliose lichens (*Parmelia sp.*), a few small mosses seldom found in fruit, with occasional stunted stragglers from the next zones.

The outermost zone of vegetation is the lichen formation. It extends from the bare rock back until the soil has reached a depth of about a decimeter, when it gives way to the Vaccinium zone. The characteristic plants are:

CLADONIA *spp.*
*Polytricum spp.*
*Lechea minor*
*Panicum sphaerocarpon*
*Carex* (two or three species, including *C. triceps.*)
*Houstonia longifolia*

There are also numerous waifs from other associations. On this account the composition of the zone varies greatly from place to place

and from year to year in the same place. It is indeed the rocky ground in which the seeds of many plants fall and spring up quickly but wither away for lack of a root when exposed to the scorching sun. None but the cryptogams in the above list can be considered as constant inhabitants. But they are never found without the admixture of some seed plants, whether of the species listed above or others.

Most of the waifs here present are stragglers from the nearby forest, but two or three are interesting in that they do not occur in the forest. *Ambrosia elatior* found but little place in the primaeval vegetation of the region, since it is dependent on strong illumination, which was denied all of the plants on the forest floor. It is interesting to find it as a frequent inhabitant of such places, whether as an original native or as an introduced weed. *Hypericum drummundii*, which

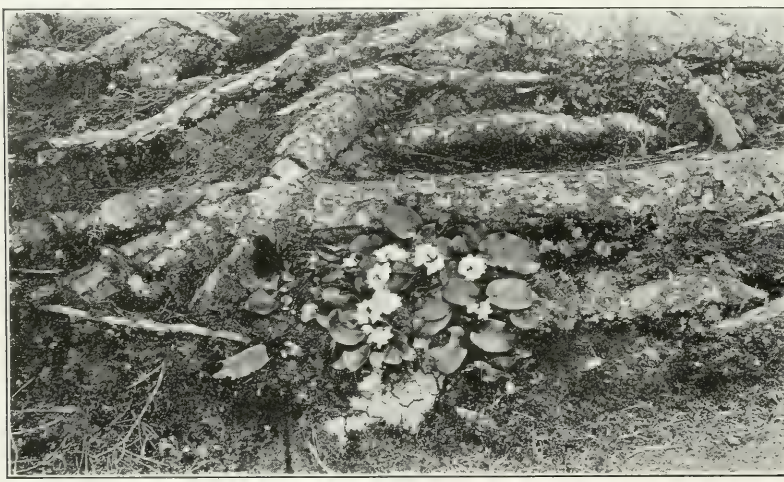

Fig. 17. A Small Plant of Trailing Arbutus Among the Roots of the Pines at the Edge of the Cliff.

reaches its extreme eastern limits in this area, was found in a single station in such a lichen formation. It was abundant in 1909, but very scantily represented in 1910.

Following the Cladonia association is a transitional shrub zone composed of:

| | |
|---|---|
| VACCINIUM VACILLANS | *Smilax rotundifolia* |
| *Polycodium staminium* | *Kalmia latifolia* |
| *Gaylosaccia baccata* | *Lespedeza repens* |
| *Epigaea repens* (fig. 17) | *Lechea minor* |
| *Gaultheria procumbens* | *Hypnaceae sp.* (forming tufts) |
| *Mitchella repens* | |

Together with these are numerous individuals from the lichen zone on one side and the forest on the other.

This zone is in reality merely an extension of the underbrush of the

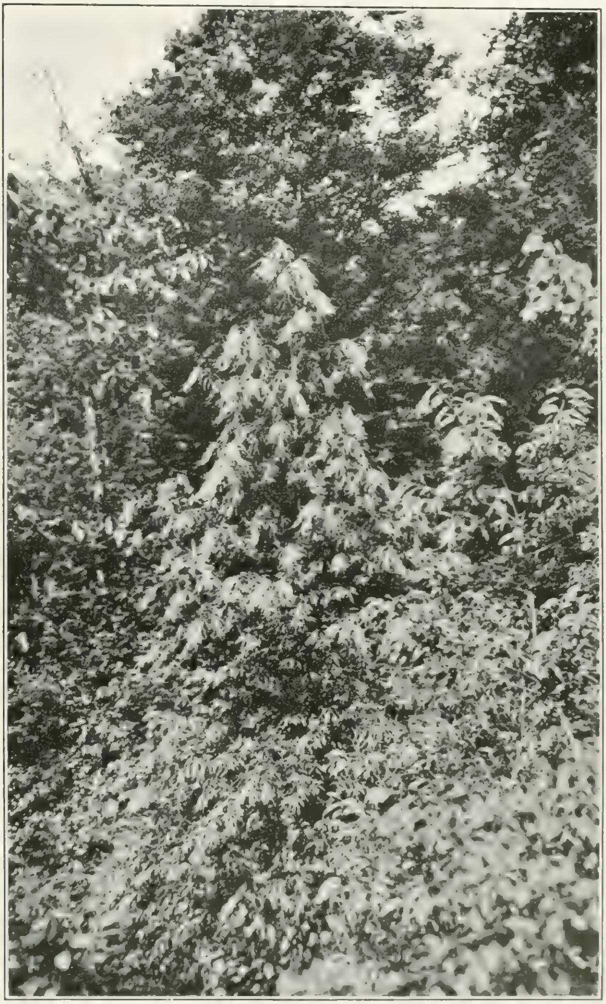

Fig. 18. Fruiting Oxydendrum in the Oak Forest. At the Left Castana dentata. At the Right Acer rubrum. In the Background Quercus sp.

pine forest behind it on to thinner soil than can support tree growth.

*The Pine Forest.* The zonal series is completed by the pine forest, which occupies the poorest soil capable of supporting arborescent plants.

It bears a general resemblance to the pine barrens common everywhere below the border of the glacial moraines. Its principal component species are:

| | |
|---|---|
| PINUS RIGIDA | *Gaultheria procumbens* |
| *Pinus virginiana* | *Panicum dichotomum* |
| *Quercus velutina* | *Chimaphila maculata* |
| *Castanea dentata* | *Meibomia rotundifolia* |
| *Oxydendrum arboreum* | *Isotria verticillata* |
| *Vaccinium vacilans* | *Solidago nemorosa* |
| *Gaylosaccia baccata* | *Houstonia longifolia* |
| *Polycolium staminium* | *Hieracium venosum* |
| *Kalmia latifolia* | *Panicum sphaerocarpon* |
| *Epigaea repens* | *Cunilla originoides* |
| *Smilax rotundifolia* | *Lespedeza hirta* |
| *Smilax glauca* | *Lespereza repens* |
| *Amalancier canadensis* | *Lespedeza procumbens* |
| *Rosa virginiana* | |

Together with these are numerous seedlings from other associations. Saplings of *Hicoria ovata* are nearly always present and here, as everywhere else, *Acer rubrum* comes up abundantly but attains no great size.

*The Oak Forest.* The pine forest occurs throughout the region on the more exposed ridges. Where the ridges become wider and the conditions are less severe, the pines gradually give way to the hard woods and a mixed oak forest is developed in which QUERCUS PRINUS is sometimes the dominant tree and occasionally occupies the ground almost to the exclusion of other arborescent species. With it are more usually present, however:

| | |
|---|---|
| *Quercus alba* | *Hicoria minima* |
| *Quercus velutina* | *Hicoria ovata* |
| *Oxydendrum arboreum* (fig. 18) | *Nyssa sylvatica* |
| *Castanea dentata* | *Acer rubrum* |

In the underbrush the heaths give way to the grapevine (VITIS BICOLOR), which is quite as typical a representative of the association as the oaks. With it are:

| | |
|---|---|
| Cynoxylon (Cornus) florida (an under tree.) | *Smilax glauca* |
| *Smilax rotundifolia* | *Rosa virginiana* |
| | *Viburnum acerifolium* |

The most characteristic plants of the herbage are:

| | |
|---|---|
| *Meibomia nudiflora* | *Linum virginianum* |
| *Meiboma rotundifolia* | *Monotropa uniflora* |
| *Dasystoma laevigata* | *Hypopytis americana* |
| *Tityhymalopsis (Euphorbia) corollata* | |

The upland oak forest originally covered a large part of the country, but it is very much restricted at present. Its boundaries coincide with the limits of arable soil. It has therefore been largely cleared away and is now to be found only in remnants around the borders of the fields. Its composition has, moreover, been greatly modified by the operations of the woodcutter, who has cut out the more valuable timber, leaving behind the inferior sorts to replenish the forest. As a result of this kind of lumbering the fascies through most of the oak forest has become the worthless black oak (*Quercus velutina*).

The two types of upland forest which have been described are the extremes between which are all intermediates. Most of the upland forest seen in the area, indeed, belongs to neither the one nor the other, but varies in composition, now approaching one now the other. For this reason and because it meets and intergrades with almost all of the other associations of the area, the oak forest is the most difficult of them all to characterize satisfactorily. The most noteworthy of these transitions, perhaps, is to the Liriodendron forest of the lowlands, with which it gradually merges at the heads of the ravines.

*The Talus Association.* The plant society covering the talus slopes at the bases of cliffs with south exposure is closely similar to the oak forest of the uplands. It should be explained, however, that the talus slope is very different from an ordinary talus slope. It is not made up of fragments of fallen rock, but of sand, which rattles down from the cliffs together with considerable amounts of vegetable debris which, on account of the porous character of the soil, are to a large extent oxidized directly without humification. The vegetation of these slopes differs from the oak forest principally in an admixture of plants from the rocks. *Quercus prinus* is more abundant and is accompanied by *Castanea dentata*, *Betula lenta*, *Mitchella repens*, and *Gaultheria procumbens*.

## THE ROCK DWELLING PLANTS

Beside the forests, the most considerable body of vegetation is that which occupies the rocks. For the most part, however, the plants of the rocks can be better considered as individuals than as organized into definite associations. This is not only because the plants are so far apart that they could in any case be understood to form only a very open association, but also because many of the crevice plants are so erratic in their occurrence that there is no very definite composition

to the flora of the rocks. In one place the rock may be occupied by a given set of plants, while in the next hollow, under entirely similar conditions, different plants appear. This is well illustrated by the

Fig. 19. The Cliff at the Head of "The Gulf."
The figure at the top gives the scale. For list of vegetation see page 283.

distribution of *Asplenium montanum* within the region. It was first found for a few rods along a cliff at Sugar Grove; it has been found at the mouth of Clear Creek, again on Little Rocky branch and at

Cedar Falls. In each of these stations there are a few dozen clumps, but nowhere else has it been found, though search has been made in hundreds of likely places. The case of *Asplenium montanum* is extreme, but the crevice plants in general are sufficiently similar to it in their occurrence to make it inadvisable, except in the few instances given below, to try to group them into definite associations.

Moreover, a large proportion of the plants of the rocks really belong in neighboring associations and are merely chance seedlings of plants able to endure the conditions of the cliff. This is well illustrated by the flora of a cliff at Old Man's Falls at the head of "The Gulf," which is exposed to the burning sun all day long and presents very severe conditions. In this particular cliff the greater part of the vegetation is made up of woody plants which alone are considered here on account of the difficulty of listing the smaller herbs because of the height and inaccessibility of the cliff (fig. 19). They are:

| | |
|---|---|
| *Betula lenta* | *Pinus virginiana* |
| *Gaylosaccia baccata* | *Kalmia latifolia* |
| *Tsuga canadensis* | *Amalancier canadensis* |

As already pointed out (page 270), *Betula lenta* has a root system requiring a supply of easily available water, such as is furnished in the crevices. With this requirement met it grows almost anywhere, from such exposed cliffs to densely shaded bottom lands. *Pinus virginiana* and *Gaylosaccia baccata* belong in the forest on top of the cliff, but are able to grow almost anywhere they can get a foothold. *Kalmia latifolia* is pre-eminently a sun-loving plant with large powers of endurance of all sorts of conditions. It is accordingly frequently found on exposed cliffs and in the primeval forest may have been confined to such places for lack of space elsewhere, but it reaches its best development in habitats where soil conditions as well as light exposure are more favorable, as, for instance, in pastures. The hemlock obviously belongs in the forest below, tho its root system resembles that of the birch and its distribution is controlled by the same factors. This leaves as a cliff plant only the *Amalanchier* (fig. 20), which seems to show a preference for steep places regardless of other conditions.

Even of those plants which are habitually rock dwellers some give clear evidence that they are so because crowded out of other habitats rather than from any preference for the rocks. *Polypodium vulgare*, for example, is for the most part as fastidious in its choice of rocky habitats as any plant in our region, but under special circumstances it

may leave the rocks and grow on the ground, or on the bases of the trees, as in the hemlock forest in Little Rocky branch, where such habits are permitted by the very great humidity, together with the absence of fall-

Fig. 20. Shad Bush (Amalanchier) on the Cliff Overlooking the Canyon of Queer Creek.

ing leaves and of competition of other plants. Likewise, when removed to a garden and competing plants artificially eliminated, it thrives well on the ground. This, moreover, seems to be an entirely normal habitat

in some regions. In Maine, Merrill[1] reports it as carpeting "the top of most of the ledges, or hanging gracefully over their brinks, or nestling beneath some evergreen tree, whose branches spread out their protect-

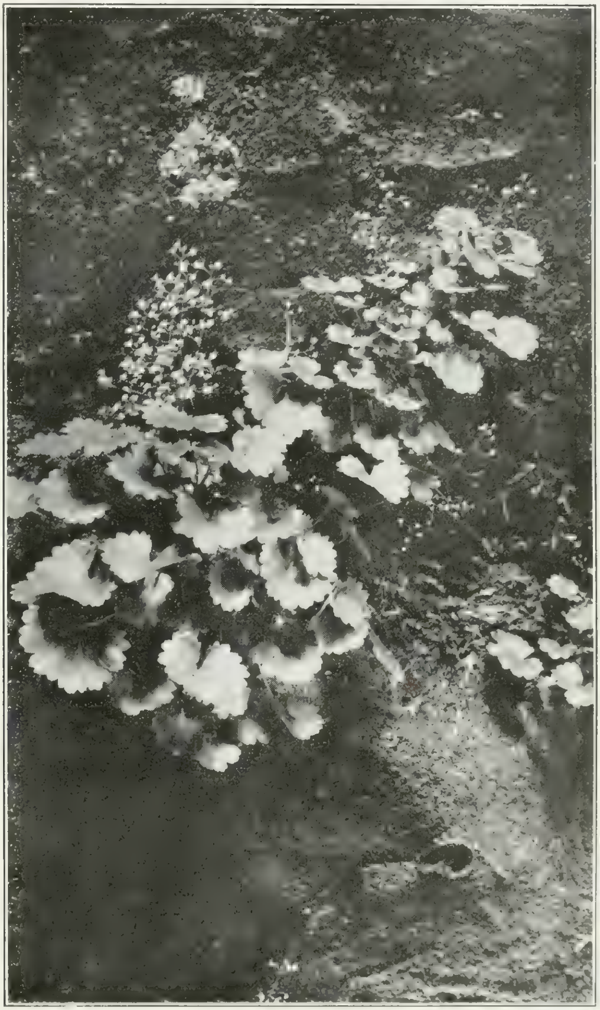

Fig. 21. Sullivantia Growing on the Face of the Cliff.

ing arms." At Sugar Grove the plant is quite limited, except in a few stations, to the edges of the rocks, neither carpeting their tops

1. Merrill, H. W. Polypodium vulgare in Maine. Am. Fern Jour. 1: 7-9. 1910.

nor running far onto their perpendicular faces. In other regions this same species is found in habitats that seem to an American botanist almost unbelievable. Warming[2] mentions it as occurring on gray sand dunes in Europe. Such habitats are entirely inexplicable on the hypothesis of a preference of Polypodium for any one of them, but are entirely consistent with the view that this species has been crowded out of the more favorable habitats and must grow where it can.

Doubtless there are crevice plants which have decided preferences for their habitats, and indeed some such occur in the present region, but the writer has been surprised to find that such other rock-dwelling ferns as *Camptosorus rhizophyllus*, *Asplenium trichomanes*, and *Asplenium montanum* grow thriftily in an ordinary garden bed. One may observe the same thing over and over again if he will read in the catalog of such a florist as Edward W. Gillett, who makes a specialty of cultivating the native plants, the directions given for managing various plants. One finds there that all of the cliff ferns succeed well if grown in a bed with good drainage, including, besides those mentioned above: *Pellaea atropurpurea*, *Cheilanthes gracilis*, *Polypodium vulgare* ("which will adapt itself to almost any kind of soil not too wet") and *Woodsia illevensis*. Similar directions are also given for such chasmophytes as *Campanula rotundifolia*.

*Sullivantia Cliffs.* Wherever, under a waterfall or elsewhere, water trickles slowly down over an overhanging cliff sufficiently well illuminated, Sullivantia is apt to occur. It seems not to thrive except where its roots are kept constantly wet. In such situations it sometimes almost covers the face of the rock with its beautiful glossy foliage. Sullivantia is one of the plants which must certainly be classed as preferring the rock to all other habitats. It is never found far away from the cliffs, and though by far the larger proportion of its seeds must drop down on to the ground below the cliff, it only is rarely that one finds it growing there (fig. 21).

*Isolated Boulders.* The structure of the sandstone is such that along every ravine the cliffs are lined with large boulders which have cracked off and gradually slumped away down the slope. For the most part these rocks are occupied by societies occurring in other situations and already described, such as the shade-loving herbage of the forest floor or the huckleberry brush of the cliff top, according to the conditions prevailing on the particular rock. But there is at least one society which reaches its best development only on such boulders.

2. Ecology, p. 267.

*The Unifolium Society.* This is the Unifolium society, composed almost purely of *Unifolium canadense*, or mixed with the partridge berry (*Mitchella repens*) (fig. 22). This association occurs on shaded, flat-topped boulders, which in the course of time become covered with a few inches of almost pure sand derived from the decay of the rock beneath. Isolated as they are, plants in such habitats have no access to a supply of permanent ground water, but are dependent on the

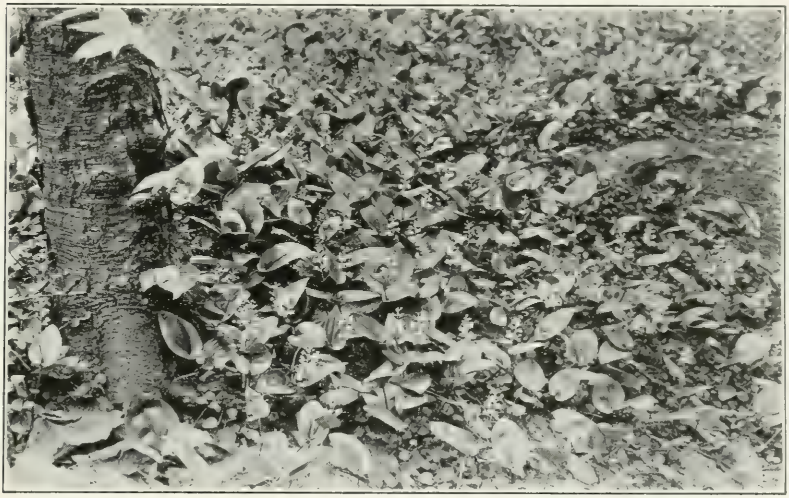

Fig. 22. "Wild Lily of the Valley" (Unifolium) on a Detached Boulder. Betula lenta at Left.

amounts which can be conserved from rainfall in the scanty substratum. Such water is, of course, very meagre, the more so since the habitat is not adapted physically to retain water, and at the same time drains freely on all sides. When such rocks are exposed to the dessication of direct sun and wind, none of the seed plants can endure the conditions, but when protected by dense shade of the forest canopy above them, Unifolium develops thriftily. This plant is not, however, limited to isolated boulders, but occurs all through the area in numerous situations, varying from this periodically xerophytic habitat to the extremely mesophytic hemlock forest. It may therefore be inferred that the purity of the association is due not to any preference of Unifolium for the habitat, but to the inability of other plants successfully to invade it.

*The Caves.* Altho not, strictly speaking, always rocky habitats, the flora of the caves is clearly most nearly allied to that of the rocks. Altho they have some elements in common, the moisture content of these habitats separates them sharply into two classes.

*Dry Caves.* Old Man's Cave (fig. 23) is the dryest of the large caves. Its roof overhangs sufficiently to protect it from all rainfall,

Fig. 23. Old Man's Cave. Aralia spinosa in Foreground. The ladder gives the scale.

and it has a southeast exposure, so that it receives sunlight till nearly noon. The sand which covers the floor is perfectly air-dry, very fine, and dusty enough to be unpleasant. It is totally barren except where water drips down from above or oozes out from the crevices of the rock, and is really a small patch of desert in the midst of luxuriant mesophytic habitats. Similar conditions are presented by many other caves of all sizes, down to mere ledges. In many of them, as in Old Man's Cave, the floor is considerably above the general level of the bottoms of the ravines in which they occur. In others the floor of the cave is continuous with the talus slope at the base of the cliff, in which case, if the conditions are not too severe, the flora is nearly allied to that of the talus slopes in general. (See p. 281.)

*Verbascum Thapsus* is perhaps the most characteristic plant of the dry caves, being nearly always found there. By reason of its very long, slender roots, which extend far and wide through the loose sand, and the protective hairy investment of the leaves, it is able to endure more severe conditions than any other plant whose seed reaches these places.

*Muhlenbergia diffusa* is another practically constant inhabitant of the dry caves, forming circles around the points where water drips from the roof, from which it reaches out radially as far as the water supply will permit, its development varying therefore from season to season.

The high bush blackberry (*Rubus allegheniensis*) likewise always occurs in such caves, thereby exhibiting an amount of endurance of xerophytic conditions which was surprising to the writer in view of its general habitat. But it is plainly evident that the conditions are too severe for its best development, as its canes are frequently killed back and never develop as robustly as in pasture lands. It flowers and fruits freely, however.

In Old Man's Cave a conspicuous place is taken by the angelica tree, *Aralia spinosa*, altho this cannot be said to be a general inhabitant of the caves, since it is rare north of Queer Creek.

*Wet Caves.* When the caves are moist and at the same time well illuminated, their flora differs but little from that of the forest floor. When, however, a cave is dark, all other conditions being favorable, the vegetation becomes arranged in something like a zonal series, according to the minimum light requirements of the constituent species, each of

which follows back into the cave as far as its particular light requirement will permit. A considerable number of species are frequently found in such habitats, but most of them must be classed as accidental. Among the few which seem to have a somewhat definite place in such

Fig. 24. A Wet Cave Occupied by Ferns (Dryopteris marginale & D. spinulosum) as far back as the Illumination Permits. Beyond them a Zone of Lichens. In the Foreground a Dead Cane of Sambucus racemosus.

habitats only three need be mentioned: *Sambucus racemosa,* the red elderberry, is oftentimes to be found only in such habitats, being apparently crowded out of other habitats. *Dryopteris marginalis* and *D. spinulosa* are, however, the most conspicuous and constant inhabitants of the wet caves. They follow far back into the weak light where, undisturbed by other vegetation, they form very beautiful and perfect rosettes, conspicuously oriented, of course, toward the source of light (fig. 24). Beyond the reach of any vascular plant is a zone of crustose lichens which covers the surface of the rock fragments.

## THE GUILD OF SHADE-LOVING EVERGREEN HERBS

Most abundant on shaded rocks, tho often found in other habitats, especially in the upland forest, is a guild of plants which requires separate consideration. These are the prostrate or acaulescent herbs with evergreen or hibernating leaves. They share the advantages

possessed by all evergreen undergrowth in being able to carry on photosynthesis during the months when the trees are bare. But they labor under a disadvantage which very strikingly limits them to a peculiar class of habitats—namely, those which are free from a covering of fallen leaves.

The situation will be evident from the consideration of a typical case, that of the Rattlesnake plantain, *Peramium pubescens* (fig. 25). Its rosettes of leaves do not appear until late in the season, but persist through the winter and well into the following season. With its prostrate stem fixed on the ground, and its slow growth, it has no means of surmounting a covering of leaves, so that if deeply covered it is inevitably smothered. Not only is it deprived of light during the winter; it sends up no erect shoots to pierce the leafy blanket in the spring. The plant grows in varied habitats, such as rocks, hemlock

Fig. 25. Rattlesnake Plantain (Peramium pubescens) on a Boulder in the Forest

forests, bare soil, and the banks of streams. Young plants may be found almost anywhere, as would be expected from seeds scattered by the wind, but well-developed clumps are only to be found in situations remaining nearly free from a winter covering of leaves. When, per-

chance, a few leaves fall around it, the petioles bend up nearly to a vertical position, raising the leaves to a certain extent above the obstruction.

As in every other guild of plants, the members of this one are not all typical, but intergrade with various other guilds, from lianes to rosette plants, and in so far as they depart from the characters of the guild, they escape its limitations. Some of them, like the partridge berry, *Mitchella repens,* have a sufficient power of growth to raise themselves above a leafy blanket which may be heaped upon them. Thus, though normally prostrate, this plant forms ascending shoots a decimeter or two high when it is buried under leaves. Nevertheless, its distribution is largely controlled by this one factor. It is perhaps most at home on sloping boulders and the edges of banks, but covers the ground in the hemlock forest where the falling leaves are so small as to pass down between its blades. In one case it was found even in the deciduous forest on a pile of stones, only a decimeter or so in height, but just sufficient to stand out from among the leaves. Others, like *Hepatica* or *Polystichum*, send up their new leaves so early in the season that even when covered up the handicap is soon thrown off. In such cases, covering beneath fallen leaves means simply the loss of photosynthetic activity during the winter, which might be supposed to be inconsiderable. Nevertheless these plants usually attain their best development in places too steep to permit the accumulation of leaves upon them. Still others, like the wintergreen, *Gaultheria procumbens*, are not strictly prostrate, but in their aerial parts approach more nearly to the upright condition. This plant, together with some others, is an Oxyphyte, and this character combines with the one under discussion to limit it to situations free from leaf fall.

Doubtless all of the ordinary biennial rosette plants, such as the shepherd's purse, would likewise be sensitive to a covering of leaves, but with them this is not an important factor because they are sun-loving plants of exposed situations, where leaves would never accumulate in any case. It is only for plants growing beneath the forest canopy that this factor can become of importance.

The plants of the Sugar Grove area which belong to this guild are:

1. Typical shade-loving evergreens with leaves appearing late in the season:

| | |
|---|---|
| *Peramium pubescens* | *Polypodium vulgare* |
| *Pyrola elliptica* | *Epigaea repens* (fig. 17) |
| *Camptosorus rhizophyllus* (fig. 26) | |

2. Shade-loving herbs with hibernating leaves replaced in spring by new ones:

*Hepatica acutiloba*
*Carex plantaginea*
*Dryopteris marginalis*
*Tiarella cordifolia*
*Hepatica hepatica*
*Dryopteris spinulosum*
*Unifolium canadense*

Fig. 26. The Walking Fern (Camptosorus rhizophyllus).

3. Evergreen herbs with leaves or shoots ascending sufficiently from the ground partially to surmount a blanket of fallen leaves:

*Mitchella repens*
*Lycopodium lucidulum*
*Gaultheria procumbens*
*Lycopodium complanatum var. flabelliforme*

## THE UPLAND THICKETS.

*The Sumac Thicket.* There are many steep slopes in the area where the rock comes so close to the surface as to prevent the growth of trees, but yet is not precipitous and retains a thin covering of soil. Here a thicket develops which is dominated by RHUS COPALLINA and ANDROPOGON SCOPARIUS, with the following secondary species:

*Malus glaucescens*
*Rubus procumbens* (Dewberry)
*Smilax glauca*
*Rubus alleghiensis* (Highbush B. B.)
*Specularia perfoliata*
*Meibomia canescens*
*Potentilla canadensis*

This association originally occupied a very small amount of territory in this area, but since the land has been cleared and cultivated a

very large and ever-increasing proportion of the area is growing up into thickets very similar to the natural Sumac Thicket which, like the Riverbank association, may be said therefore to have greatly extended its boundaries since the advent of man. These Old Field associations are not, however, altogether similar to the natural societies, but show a considerable admixture of species not found in them.

*The Old Field Associations.* It has already been remarked that the uplands require very careful handling to prevent washing and wasting of the scanty soil. Thousands of acres throughout the region have thus gotten away from their owners and become worthless for agricultural purposes. In these lands and other worn-out fields there has developed a somewhat definite association which covers a larger portion of area than any of the natural associations. In many respects it resembles markedly the Sumac Thicket just described, but its soil, though very poor, is not so closely underlain with hard rock, and so permits the growth of numerous species which do not find a place in the natural thicket.

The first plants that come into such fields, often appearing in numbers before abandonment, are ANDROPOGON SCOPARIUS and A. VIRGINICUS, which sometimes occupy the ground almost to the exclusion of other species.

After them, or in pastured land instead of them, appear various weedy plants, among which are:

| | |
|---|---|
| *Ascyron hypericoides* | *Houstonia longifolia* |
| *Gnaphalium decurrens* | *Hedeoma pulegreoides* |
| *Meibomia canescens* | *Meibomia obtusa* |
| *Potentilla canadensis* | |

Next come in the mountain sumac, RHUS COPALLINA, together with the following plants completing the association:

| | |
|---|---|
| *Rubus procumbens* (Dewberry) | *Solidago nemoralis* |
| *Lespedeza hirta* | *Rubus alleghiensis* (Highbush B.B.) |
| *Corylus americana* | *Hypericum prolificum* |
| *Malus glaucescens* | *Titythmalopsis corallata* |
| *Smilax glauca* | *Solidago juncea* |
| *Ibidium gracilis* | |

After these plants have fully occupied the territory, reforestation begins by the appearance of some of the arborescent species, among which the first comers are often the *Sassafras* and the Persimmon (*Diospyros*), together with the pines, P. RIGIDA and P. VIRGINIANA; which finally take possession to the exclusion of other trees.

The Sycamore (*Platanus*) often appears at this stage and grows vigorously even on land entirely denuded of its soil and exposed to extreme drouth. At the same time its absence from the undisturbed bottom land associations, such as the swamp and the birch bottom land, is not less noteworthy than its presence here. The explanation is to be found in the fact that the sycamore is not, as commonly supposed, a water-loving tree, but rather requires a large amount of light. In the primeval forest sufficient light was to be obtained only along the larger water courses, and for this reason, rather than because of a need of a large amount of water, the sycamore was found only along the streams.

In many places, especially where washing has been severe, the old field association develops only fragmentarily and the pines, which take some time to get started, are the first woody plants to occupy the land, so that reforestation begins without the intermediate steps more usually found. But in any case the pine forest comes to occupy most of the old fields, while on the ground, in more or less profusion, depending on the density of the shade, are most of the plants of the preceding thicket formation, together with *Chimaphila maculata* and the saprophytic *Coralorhiza odontorrhiza*.

Although the soil of such forests would appear to be very poor, it is interesting to note that occasional specimens of *Liriodendron* are often found among the pines and appear to thrive. None of the tulip trees observed in such situations had reached a very great age, and most were broad topped, not slender like the trees of the coves. But their thrifty appearance would suggest the feasibility of seeding down such land with Liriodendron, which is at once a more rapid grower and a more valuable timber tree than the pines which it would replace. While one would not care to recommend this practice widely on the basis of such fragmentary observations, it would appear to be clearly worth while to experiment in such situations with Liriodendron on a small scale with a view of determining its feasibility for general use.

The normal succession, however, would never be a forest of Liriodendron, but rather that already described in the upland forest. Although none of the second growth pine forests observed had attained any great age, it is altogether probable that they would come to resemble closely the virgin pine forest already described and that they would finally give way to the oak forest.

## ECONOMIC ASPECTS

No scientific study is necessary to demonstrate that the land of this area is becoming poorer and poorer as its resources are dissipated under the present wasteful system of management. Everywhere one sees abandoned houses; in some parts of the area hardly half the houses are now occupied. Old "worn-out" fields are numerous and the number is increasing rapidly year by year.

The causes which have led to this condition are several: First, the greatest natural resource of the area was its timber. This has been cut off to such a large extent that it is difficult to find even small patches of undisturbed forest for botanical study. Lumbering is usually carried on in one of two ways, depending on whether the timber is to be made into railroad ties or sawed into lumber. Railroad ties, consisting especially of Chestnut and Rock Oak, are usually cut and worked by the owner of the land during the winter season. The large timber having long since been removed, those trees of sufficient size to make ties are felled and worked up in situ with but little disturbance of the young growth around them. Except from the danger of fires from the unused refuse and the fact that by this means the undesirable species are left to grow and multiply while the valuable woods which are cut out become scarcer and scarcer, this method of lumbering when conservatively practised has much to recommend it. When, on the other hand, a portable sawmill is brought into the country, its crew usually buys the standing timber from the owner of the land. The lumberers having no interest in the land, proceed to skin it, cutting every stick capable of being made in a piece 2 by 4 inches or larger, with no regard for the future. This method of lumbering is the most important cause of the increasing poverty of the country. While the land-owner usually secures a price sufficient to compensate him for the loss of the land, as well as the timber, the community is permanently impoverished by the loss of a forest which, if conservatively handled, would have been a permanent asset.

Second, with the removal of the timber soil acidity* becomes very prevalent and more and more land becomes utterly unfit for cultivation.

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I apply the word acidity here, for want of a better term, to soils which when moist promptly redden blue litmus paper. In using the term I would not be understood as stating that the reddening of litmus paper is a criterion of acidity, or of taking any position in the controversies which are waging regarding this puzzling problem. I have merely noticed a very marked and definite correlation between the wild vegetation and the reaction of the soil to litmus paper.

Thus many exposed fields are discarded as worn out, when the worst trouble apparently is excessive acidity.

Third, the slope of most of the land is so great that it is in danger of washing whenever cultivated. Hundreds of acres throughout the area which might have continued as fairly good upland pastures have become hopelessly gullied "bad lands" (fig. 27) because the owner attempted to cultivate them.

This state of affairs is generally accepted as irremediable on the supposition that the land is so poor that early exhaustion is inevitable. Long observation of the deterioration of this land, however, has con-

Fig. 27. A Badly Washed Upland. Little but Dewberries (Rubus procumbens) Can Survive the Erosion.

vinced the writer that the case is by no means hopeless. While he would not pretend to recommend a remedy on the basis of present knowledge, there is abundant prospect that an experimental study of the situation would develop a system of management which would be profitable in the long run to both the land-owner and the community.

If the conditions described were confined to the Sugar Grove area alone there would be little justification for the expenditure of the time and money necessary to determine the best means of meeting the situation. But while such conditions may reach their climax in the present area, they are more or less general over all of the unglaciated portions

of southern and southeastern Ohio. On this account the determination of the most profitable method of managing these hill lands is a matter of very great importance to the welfare of the whole state and ought on that account by all means to be taken up without delay.

The progress of the deterioration of the land in this section is difficult to follow in the fields where the vegetation is made up of annuals and cultivation introduces many complications. But in the woods, where the plants are perennial, the gradual change in the vegetation as the land deteriorates and the factors which are at work are comparatively easy to observe.

Fig. 28. West Bank of Ravine. Note Leaves and Young Growth.

The cause may be summed up in the one word exposure. Wherever through thinning of the forest the wind is allowed to get in to the floor of the forest, the vegetation quickly changes. In the underbrush, plants characteristic of rich humus give place to others characteristic of barren hillsides, and the seedlings which are to replace the forest trees are of species of the same type. Thus the rich lowland forest is rapidly giving way to the poor upland forest. The most characteristic result of clearing the land is thus a descent of the upland vegetation into the lowlands.

The most striking examples of this descent of upland vegetation occur in north and south ravines, where the best timber has been culled out but the forest has not been cleared away. On the west slope of such ravines the lowland forest usually maintains its ground, but on

the opposite east bank there develops an association resembling closely the upland forest, especially in the character of its undergrowth. Typical examples are to be found in a branch of Brushy Fork, located in the southwest ¼ of section 9, Berne Twp., and in the hollow below Cantwell Cliffs, at the head of Buck Run.

On the west bank of such ravines the ground is covered with a deep layer of leaf mold in which there is a rich development of spring flowers, such as *Trillium grandiflorum* and *Galeorchis spectabilis,* unless, as in the Brushy Fork ravine (fig. 28), the ground is too heavily shaded.

On the opposite slope, however (fig. 29), the undergrowth comes to be made up largely of plants characteristic of the extreme upland forest, such as:

| | |
|---|---|
| *Kalmia latifolia* | *Hieracium venosum* |
| *Vaccinium vacilans* | *Viola hirsutula* |
| *Gaultheria procumbens* | *Polytricum sp.* |
| *Epigaea repens* | *Cladonia sp.* |
| *Gaylosaccia baccata* | *Tuft-forming Hypnums* |

Fig. 29. East Bank of Ravine Shown in Fig. 28. Note Absence of Leaves and Saplings.

It is clear at a glance that the more commonly considered ecological factors must be closely similar on the opposite sides of such ravines. Since the axis is north and south the light received on the two sides must be equivalent and there can be but slight difference in the amount of rainfall. The soil being residual derived from the weathering of the

same rocks cannot have differed, in the beginning at least, in any important respect on the two sides. The only obvious difference between the two slopes is the condition of the surface of the ground. The west slope is covered with a deep carpet of fallen leaves and leaf mold while the opposite slope is swept bare of leaves by the wind so that there is little or no humus formed and the ground is somewhat more exposed to erosion from surface runoff. The soil of the west bank gives a neutral or faintly acid reaction to litmus paper. That of the east bank, on the other hand, gives a very strong and almost instantaneous red reaction. This is remarkable in view of the abundance of organic remains which must liberate various acids in course of humification in the neutral soil while the opposite acid bank is free from any such source of acidity. Repeated tests throughout the area have uniformally shown that wherever the characteristic upland forest develops, there the soil gives a strongly acid reaction to litmus paper. The soil of the lowland forest, on the other hand, always gives a faintly acid or neutral reaction to the same test.

Although such conditions have often been ignored in American ecological papers, they are clearly recognized in Europe. Warming in his "Ecology," for example, speaks of the importance of sour humus again and again. On page 62 he describes conditions practically identical with those found in the Sugar Grove region as follows: "Raw (sour) humus appears in forests, especially in places exposed to wind, while ordinary humus, with its earthworms and other animals, reigns in places sheltered from dessication; when ordinary humus in the beech forest has given way to raw humus because of timber falls and such like, then the beech, being no longer capable of regenerating, disappears, and is often replaced by calluna heath."

While the situation is more complicated in the case of cultivated fields, it seems not unlikely that exposure is an important factor in increasing their sterility just as with the forests. This probability together with the fact that exposure and danger from wash in large measure go hand in hand would seem to lay down very clearly the lines along which experimentation should proceed.

The only practicable method of reducing exposure is, of course, reforestation. Reforestation of all washed slopes and of all in danger of washing, would not only save the soil in many fields where it is certain to be washed off sooner or later, but would provide windbreaks sufficient to protect the larger part of the more level upland fields.

The best and most profitable method of accomplishing reforestation under the varied conditions presented are of course matters to be determined by experiment. But it cannot be doubted that tree planting would be profitable on much land that is now going utterly to waste. White pine (*Pinus strobus*) has been recommended as the best tree to plant in this sort of country, but in view of the imminent liability of the introduction of the pine rust (*Peridermium strobi*) it is doubtful whether this species should be used. The observations reported above (p. 295) indicate the advisability of giving the tulip-tree (*Liriodendron tulipifera*) a trial even on the steep slopes. The probability is that it would not succeed in some of the most difficult situations which might be first seeded to some quick-growing cover. But where it could be grown it would appear, on account of its rapid growth, valuable timber, and freedom from insect and fungus enemies, to be the most promising species with which to experiment.


Map Showing Roads and Localities in the Sugar Grove Area.
Scale 3 miles per inch.

## FLORA

The Sugar Grove region has been collected over by all of the Botanists resident in Central Ohio from the time of Sullivant down. The specimens gathered by later collectors have to a large extent been deposited in the State Herbarium at Columbus until there has accumulated a fairly representative, though by no means complete, collection of the plants of the region. The list which follows is mainly a compilation of those species represented in the State Herbarium from either Fairfield or Hocking Counties. Some, however, are taken from Bigelow's list (see below) or were noted but not collected by the writer. An effort has been made to collect all those species whose occurrence or determination any one might wish to verify, but many of the commonest plants, such, for example, as *Rumex obtusifolius*, were simply noted as seen but were not pressed. For the protection of those who use the catalog, however, all species not represented in the State Herbarium are specifically noted.

The writer has not attempted to verify the determinations systematically, since they were all made by competent authority and most of them were verified by the late Prof. W. A. Kellerman. But whenever a species has aroused suspicion because apparently out of range or for any other reason, the specimen has been carefully scrutinized.

There may be grounds for criticizing the writer for including all plants known from the two counties in which the area lies rather than confining the list to plants known to occur in the region proper. Since, however, the region has no sharp boundaries and its limits have been somewhat arbitrarily fixed by the writer it will be seen that it would be altogether impossible to determine whether a given herbarium specimen with a more or less indefinite record of locality was collected within its limits or not. The increase in the apparent size of the flora from this cause, however, is not believed to be great, because, except for the special conditions in Buckeye Lake, the country is of sufficiently uniform character to make it probable that any plant reaching either of the counties in which the area lies, occurs at least as a straggler within the area, even though it might not be easy to find it there.

In the preparation of this flora I have derived very great assistance from the unpublished manuscript of the Fifth State Catalog of Ohio Plants by my colleague, Professor John H. Schaffner, to whom indebtedness is gratefully acknowledged. The arrangement, except in minor details, follows Schaffner's phyletic system which the writer

confidently believes will be found, when once the worker becomes familiar with it, as far superior to the classification of Engler now generally used as was that to DeCandolle's which it superceded. Those unfamiliar with the new arrangement will doubtless experience some inconvenience in using it at first, but that is a difficulty inherent in any improvement. At the end, I have added a Synopsis-summary by which the location of the families may readily be found.

The nomenclature, following the Ohio list is that of the second edition of Britton & Brown's Illustrated Flora. Recent synonyms have been added where they seemed necessary or desirable to make the list intelligible to all readers.

The Sugar Grove region is unique for this part of the country in that its flora was worked up by John M. Bigelow*, more than seventy years ago. Bigelow was an able botanist, companion and friend of Sullivant, for whose ability one finds an increasing respect as he scrutinizes his work. Basing my judgment almost entirely on his remarkable list, I have great confidence in his determinations and have unhesitatingly included most of them in the present list. He found a very large number of very rare plants just on the edges of their ranges or just beyond their present range as we know it, but there are few if any "wild" reports of species entirely out of range such as one would find in the inaccurate work of a less able man. He lists 871 species and varieties all of which with two exceptions he found growing in Fairfield County. His list includes a number of plants, specimens of which are not now definitely known from Ohio. Most of these have been included on his authority marked "Fide Bigelow." Many of them are plants whose general range is such as to make their occurrence highly probable and others are so distinctive that there could be no question of their proper determination. They are:

Ranunculus reptans L. "Nfd. to Pa. northward and westward."
Delphinium carolinianum "Va. N. C., and Ga., to Ark., Mo., Minn., and Sask."
Polygola incarnata. N. J. to S. Ont., Wisc., Neb., and southw.
Trifolium reflexum. Included on state list but no Ohio specimens known to us.
Lithospermum officinale. A European escape not apparently establishing itself.
Trisetum palustre. "Mass. to Ill. and southw."
Panicularia acutiflora "Me. to Del. w. to Ohio."
Carex vesicaria. "E. Que. to B. C. s. to Pa., Gt. Lake region, etc."

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*Bigelow, John M. Florula Lancastriensis or a catalog of nearly all the flowering and felicoid plants growing naturally within the limits of Fairfield County with notes of such as are medicinal. Proc. Med. Convent of Ohio at Columbus. May, 1841, pp. 49-79.

Some of Bigelow's plants belong to species that were not well understood at the time or whose identity the writer is inclined to question for other reasons. These are not included in the list: they are:

Ranunculus pusillus. "Near the coast S. N. Y. to Fla. and Tex., n. in the Miss. basin to Mo. and Tenn."

Viola cucculata. Determination doubtful.

Viola labradorica. Determination doubtful.

Viola sagitatta. Determination doubtful.

Silene regia. Probably S. rotundifolia.

Oxalis stricta. Determination doubtful.

Acer spicatum. This is almost certainly absent now, but its habitat is such that it could hardly have become extinct. It is, however, difficult to imagine what could have been mistaken for it.

Lythrum hysopifolium. "Near the coast Me. to N. J. Also on the Pacific Coast."

Antennaria dioica. Evidently a misdetermination. European species included in Gray's manual as "found by Geo. Thurber in 1844, but not since collected."

Hicoria glabra? Queried by Bigelow.

Scutellaria nervosa? Queried by Bigelow.

Chenopodium urbicum. No Ohio specimens extant.

Polygonum hirsutum? Queried by Bigelow.

Polygonum mite. A European species.

Rumex aquaticus. Synonomy doubtful.

Juncus polycephalus. Synonomy doubtful.

"Leimanthium virginicum Willd." Synonomy doubtful.

Sparganium ramosum. Synonomy doubtful.

Potomogeton compressum. Synonomy doubtful.

Potomogeton gramineum. Synonomy doubtful.

Panicum nitidum. Synonomy doubtful.

Panicum involutum. Synonomy doubtful.

Aristida stricta? Queried by Bigelow.

Elymus villosus. Synonomy doubtful.

Isolepis capillaris. Synonomy doubtful.

Carex acuta. Synonomy doubtful.

Carex anceps. Synonomy doubtful.

Carex arida. Synonomy doubtful.

Carex bullata. "Mass. to Del., local." Formerly included in the Ohio list, but no Ohio specimens known.

Carex paniculata. Synonomy doubtful.

Carex sylvatica? Queried by Bigelow.

Carex tentaculata. Synonomy doubtful.

Carex tetanica? Queried by Bigelow.

Equisetum limosum? Queried by Bigelow.

He further reports a very considerable number of plants which are not otherwise definitely known from the region. Some of these, like *Chenopodium botrys*, are the commonest of plants, which have merely failed of notation by later workers, but many are very rare if, indeed, they are still to be found in the area. It does

not appear safe, however, to assert that any are extinct except a few species like *Cypripedium reginae* and *Dasyphora fruticosa*, which are so conspicuous that they could hardly have been overlooked if they still occurred. These are included in the list on Bigelow's authority.

## Phylum, PTENOPHYTA

Class, FELICES, Ferns.

Subclass, EUSPORANGIATAE.

Order, *Ophioglossales*.

Family, **Ophioglossaceae**, Adder-tongue Family.

Ophioglossum vulgatum L. Adder-tongue. A few plants formerly grew in Stukey's swamp. (Sec. 4, Berne Twp.) I have not been able to find any since the station was lumbered in 1912.

Botrychium obliquum Muhl. Obligue Grape-fern.

Botrychium dissectum Spreng. Cutleaf Grape-fern.

Botrychium virginianum (L.) Sw. Virginia Grape-fern. Common.

Subclass, LEPTOSPORANGIATAE.

*Felicales.*

**Osmundaceae,** Royal-fern Family.

Osmunda regalis L. Royal fern.

Osmunda claytoniana L. Clayton fern.

Osmunda cinnamomea L. Cinnamon fern.

**Polypodiaceae,** Polypody Family.

Polypodium vulgare L. Common polypody. Common on the edges of cliffs.

Adiantum pedatum L. Maidenhair fern. Common.

Pteridium aquilinum (L.) Kuhn. Brake.

Pellaea atropurpurea (L.) Link. Purple Cliff-brake. Not known in our area and generally confined to limestone cliffs, but occurs on Blackhand Cliffs, near the village of Hanover, Licking Co.

Asplenium pinnatifidum Nutt. Pinnatifid Spleenwort. Common.

Asplenium platyneuron (L.) Oakes. (A. eboneum Ait.). Ebony Spleenwort.

Asplenium trichomanes L. Maidenhair Spleenwort.

Asplenium pycnocarpan Spreng. (A. angustifolium Mx.). Narrow-leaf Spleenwort.

Asplenium montanum Willd. Mountain Spleenwort. In one hollow near Sugar Grove, at Pine Grove, on Little Rocky Branch, and at Cedar Falls.

Athyrium thelypteroides (Mx.) Desv. (Asplenium achrostichoides Sw.). Silvery Spleenwort.

Athyrium filixfoemina (L.) Roth. Lady Fern. No specimen.

Camptosorus rhizophyllus (L.) Link. Walking Fern. Commonly reputed a plant of calcareous regions, but common in our area. Not found, however, in the extremely humid hemlock ravines of the southern half of the area.

Polystichum achrostichoides (Mx.) Schott (Aspidium). Christmas Fern.

Dryopteris noveboracensis (L.) Gr. (Aspidium). New York Fern.

Dryopteris cristata (L.) Gr. (Aspidium). Crested Shield-fern.

Dryopteris goldieana (Hook.) Gr. (Aspidium). Goldie's Shield-fern. Not common.

Dryopteris marginalis (L.) Gr. (Aspidium). Marginal Shield-fern.

Dryopteris spinulosa (Retz.) Ktz. (Aspidium). Spinulose Shield-fern.

Dryopteris intermedia (Muhl.) Gr. (Aspidium).

Phegopteris phegopteris (L.) Und. (P. polypodioides Fee, Dryopteris). Long Beech-fern.

Phegopteris hexagonaptera (Mx.) Fee. (Dryopteris). Broad Beech-fern.

Filix bulbifera (L.) Und. (Cystopteris). Bulbous Bladder-fern.

Filix fragilis (L.) Und. (Cystopteris). Fragile Bladder-fern.

Woodsia obtusa (Spreng.) Torr. Obtuse Woodsia.

Dennstaedtia punctilobula (Mx.) Moore. (Dicksonia). Hay-scented fern. In this area never occurs in its customary habitat, but is limited to the faces of the cliffs.

Onocloea sensibilis L. Sensitive fern.

## Phylum, CALAMOPHYTA

Class, EQUISETEAE, Horsetails and Scouring-rushes.

*Equisetales.*

**Equisetaceae.**

Equisetum hyemale L. Common Scouring-rush.

Equisetum praelitum Raf (E. robustum A. Br.). Great Scouring-rush.

Equisetum arvense L. Field Horsetail.

## Phylum, LEPIDOPHYTA

Class, LYCOPODIEAE, Lycopods.

*Lycopodiales.*

**Lycopodiaceae,** Club-moss Family.

Lycopodium lucidulum Mx. Shining Club-moss.

Lycopodium porophilum, Lloyd & Underw. Rock Club-moss. Common on the cliffs. Easily separated from the last, but probably not distinct from it.

Lycopodium obscurum L. Tree Club-moss. Only a few widely scattered clumps, mostly in the southern half of the area.

Lycopodium clavatum L. Common Club-moss. A few clumps in the canyon above the "Gulf." Not otherwise known for more than a hundred miles to the northward.

Lycopodium complanatum L. Trailing Club-moss. Not common; confined to the southern half of the area or at least very rare around Sugar Grove.

None of the Lycopods are known to extend southward or westward in Ohio beyond the present area.

Class, SELAGINELLEAE, Selaginellas.

*Selaginellales.*

**Selaginellaceae,** Selaginella Family.

Selaginella rupestris (L.) Spring. Rock Selaginella. Found only at Kettle Hills, on the northern boundary of the area, and on a high, bare knob south of Clear Creek in section 20, Good Hope Twp.

## Phylum, STROBILOPHYTA

Class, CONIFERAE, Conifers.

*Pinales.*

**Pinaceae,** Pine Family.

Tsuga canadensis (L.) Carr. Hemlock. Common throughout the area, but occurs in pure stands only in the southern half.

Pinus rigida Mill. Pitch Pine. On the edge of its range.

Pinus virginiana Mill. Scrub Pine. On the edge of its range.

**Juniperaceae,** Juniper Family.

Juniperus virginiana L. Red Cedar. Common, but nowhere abundant.

*Taxales.*

**Taxaceae,** Yew Family.

Taxus canadensis Marsh. American Yew. Abundant in the Hemlock forest in the southern portion of the area, but absent from the northern portion.

## Phylum, ANTHOPHYTA

Class, MONOCOTYLAE, Monocotyls.

Subclass, HELOBIAE.

*Alismales.*

**Alismaceae,** Water-plantain Family.

Sagittaria latifolia Willd. Broad-leaf Arrowhead. Common in a few suitable habitats.

Alisma subcordatum Raf. (A. plantago-aquatica L.). American Water-plantain.

**Scheucherizaceae,** Arrow-grass Family.

Triglochin maritima L. Fide Bigelow.

**Potomogetonaceae,** Pond-weed Family.

Potomogeton natans L. Common Floating Pondweed. Swamps along the old canal.

*Nympheales.*

**Nympheaceae,** Water-lily Family.

Brasenia schreberi Gmel. B. purpurea Mx. Casp.). Water-shield. Fide Bigelow.

Nymphaea advena Ait. Spatterdock.

Subclass, SPADICIFLORAE.

*Pandanales.*

**Sparganiaceae,** Burr-reed Family.

Sparganium eurycarpum Englm. Broad-fruited Burr-reed. No herbarium specimen, noticed at the mouth of the first hollow north of Crystal Springs.

Sparganium americanum Nutt. Fide Bigelow.

**Typhaceae,** Cat-tail Family.

Typha latifolia L. Common Cat-tail. Along the old canal. No herbarium specimen.

*Arales.*

**Araceae,** Arum Family.

Acorus calamus L. Sweet-flag.
Spathema foetida (L.) Raf. (Symplocarpus). Skunk-cabbage. Common in suitable habitats. No specimen.
Arisaema triphyllum (L.) Torr. Jack-in-the-pulpit.
Arisaema dracontium (L.) Schott. Dragon-root.

**Lemnaceae,** Duck-weed Family.

Spirodela polyrhiza (L.) Schleid. Greater Duckweed.
Lemna trisulca L. Star-duckweed.
Lemna minor L. Lesser Duckweed.
Wolffia columbiana Karst. Wolffia. Known only from Buckeye Lake.

Subclass, GLUMIFLORAE.

*Graminales.*

**Cyperaceae,** Sedge Family.

Cyperus flavescens L. Yellow Cyperus.
Cyperus esculentus L. Fide Bigelow.
Cyperus speciosus Vahl. Fide Bigelow.
Cyperus strigosus L. Straw-colored Cyperus. Common. No specimen.
Cyperus filiculmis Vahl. Slender Cyperus.
Kyllingia pumila Mx.
Dulichium arundinaceum (L.) Britt.
Eleocharis obtusa Schultes. Fide Bigelow.
Eleocharis acicularis (L.) R. & S. Needle Spike-rush.
Eleocharis tenuis Schultes. Fide Bigelow.
Fimbristylis autumnalis (L.) R. & S.
Scirpus validus Vahl. (S. lacustris L.) Only in Buckeye Lake.
Scirpus atrovirens Muhl.
Scirpus polyphyllus Vahl.
Scirpus lineatus Mx. Reddish Bulrush. Fide Bigelow.
Scirpus cyperinus (L.) Kunth. Wool-grass.
Rynchospora alba (L.) Vahl. Fide Bigelow.
Rhynchospora glomerata (L.) Vahl. Clustered Beaked-rush.
Scleria triglomerata Mx. Tall Nut-rush. Fide Bigelow.
Scleria panciflora Muhl. Papillose Nut-rush. Fide Bigelow.
Carex asa-grayii Bailey (C. grayii Carey).
Carex bromoides Schkr. Fide Bigelow.
Carex cephalophora Muhl.
Carex conjuncta Boott.
Carex careyana Dewey. Fide Bigelow.
Carex costellata Britt. (C. virescens Muhl).
Carex crinita Lam.
Carex cristatella Britt. (C. cristata Schwein).
Carex davisii Schw. & Torr. Fide Bigelow.

Carex decomposita Muhl. Fide Bigelow.
Carex digitalis Muhl. Fide Bigelow.
Carex festucacea Schk. Fide Bigelow.
Carex frankii Kunth.
Carex gracillima Schw.
Carex hitchcockiana Dewey. Fide Bigelow.
Carex hysterecina Muhl. Fide Bigelow.
Carex intumescens Rudge. Fide Bigelow.
Carex jamesii Schw.
Carex lanuginosa Mx. Fide Bigelow.
Carex laxiflora Lam.
Carex laxiflora varians Bailey.
Carex leptalea Wahl.
Carex lupulina Muhl.
Carex lupulina var. pedunculata Dewey.
Carex lurida Wahl.
Carex oligocarpa Schk. Fide Bigelow.
Carex pennsylvanica Lam.
Carex plantaginea Lam.
Carex platyphylla Carey.
Carex prasina Wahl.
Carex pseudo-cyperus L. Fide Bigelow.
Carex pubescens Muhl. Fide Bigelow.
Carex retroflexa Muhl.
Carex riparia Curtis. Fide Bigelow.
Carex rosea Schkr.
Carex rosea radiata Dewey.
Carex shortiana Dew. & Torr. Fide Bigelow.
Carex sparganioides Muhl.
Carex squarrosa L.
Carex stellulata Goodn. Fide Bigelow.
Carex stipata Goodn.
Carex straminea Willd. Fide Bigelow.
Carex tribuloides Schkr.
Carex triceps Mx.
Carex tuckermanii Dewey.
Carex vesicaria L. Fide Bigelow. Not otherwise known in Ohio.
Carex vulpinoidea Mx.
Carex willdenovii Schk. Fide Bigelow.

**Graminaceae,** Grass Family.

Bromus ciliatus L. Wood Chess.
Bromus purgans L. Pubescent Brome-grass.
Bromus tectorum L. Downy Brome-grass.
Bromus secalinus L. Cheat. Common. No specimens.
Bromus racemosus L. Upright Chess.
Festuca octoflora Walt. (F. tenella.) Slender Fescue-grass.

Panicularia acutiflora (Torr.) Ktze. (Glyceria). Fide Bigelow. Given by the manuals from the state as reaching Ohio, but authentic specimens are not known to us.

Panicularia fluitans (L.) Ktz. (G. septentrionalis Hitch.). Floating Manna-grass. Fide Bigelow.

Panicularia torreyana (Spreng) Merr. Long Manna-grass. Otherwise known only from the northeastern counties of the state.

Panicularia nervata (Willd.) Ktz. Nerved Manna-grass.

Panicularia pallida (Torr.) Ktze. Fide Bigelow. Now known only from Ottawa Co.

Poa annua L. Low Spear-grass.

Poa pratensis L. Kentucky Blue-grass. Common. No specimen.

Poa compressa L. Wire-grass.

Poa trivialis L. Roughish Meadow-grass. Fide Bigelow.

Poa triflora Gilib. (P. flava L.) Fowl Meadow-grass.

Poa sylvestris Gray.

Poa brevifolia Muhl. Short-leaf Spear-grass.

Dactylis glomerata L. Orchard-grass. Common. No specimen.

Eragrostis pilosa (L.) Beauv. Fide Bigelow.

Eragrostis frankii Steud. Frank's Eragrostis.

Eragrostis major Host. (E. megastachya). Stinking Eragrostis.

Eragrostis capillaris (L.) Nees. Fide Bigelow.

Eragrostis pectinacea (Mx.) Steud. Purple Eragrostis.

Eragrostis hypnoides (Lam.) B. S. P. Fide Bigelow.

Sphenopolis obtusata (Mx.) Scribn. (Eatonia). Blunt-seeded Eaton-grass. Fide Bigelow. No specimens in State herbarium.

Sphenopolis pallens (Spreng.) Scribn. Tall Eaton-grass.

Sphenopolis nitida (Spreng.) Scribn.

Phragmites phragmites (L.) Karst. (P. communis Trin.) Reed. Fide Bigelow.

Danthonia spicata (L.) Beauv. Wild Oat-grass.

Trisetum pennsylvanicum (L.) Beauv. Marsh False-oats. Fide Bigelow. No specimens in State herbarium.

Deschampsia flexuosa (L.) Trin. Fide Bigelow. Now known only from Portage Co.

Nothoholcus lanatus (L.) Nash. (Holcus). Velvet-grass.

Lollum perenne L. Darnel.

Hordeum jubatum L. Squirrel Tail-grass. Common. No specimen.

Elymus virginicus L. Virginia Wild-rye.

Elymus striatus Willd. Fide Bigelow.

Hystrix hystrix (L.) Millsp. (H. patula). Bottle Brush-grass. Fide Bigelow.

Eleusine indica Gaertn. Wire-grass.

Agrostis alba (L.) White. Bent-grass.

Agrostis schweinitzii Trin. (A. perenans) Thin-grass.

Agrostis hyemalis (Walt.) B. S. P. Hair-grass.

Cinna arundinacea L. Wood Reed-grass.

Alopecurus geniculatus L. Marsh Fox-tail. Fide Bigelow.

Phleum pratense L. Timothy.

Muhlenbergia mexicana (L.) Trin. Meadow Muhlenbergia.

Mehlenbergia tenuiflora (Willd.) B. S. P. Slender Muhlenbergia.

Muhlenbergia diffusa Schreb. Drop-seed Grass.
Brachylytrum erectum Schreb.
Aristida dichotoma Mx. Poverty Grass.
Savastana odorata (L.) Scrib. (Hierachloa borealis R. & S.). Vanilla Grass. Fide Bigelow.
Anthoxanthum odoratum L. Sweet Vernal-grass. Fide Bigelow.
Panicum stipitatum Nash.
Panicum virgatum L. Switch Grass.
Panicum capillare L. Tumble Grass.
Panicum linearifolium Scrib.
Panicum dichotomum L.
Panicum microcarpon Muhl.
Panicum lindheimeri Nash. Known only from Ashtabula and Hocking Counties.
Panicum huachucae Ashe.
Panicum sphaerocarpon Ell.
Panicum polyanthes Schultes.
Panicum commutatum Schultes.
Panicum ashei Pear.
Panicum clandestinum L.
Panicum latifolium L.
Syntherisma sanguinalis (L.) Dulac (Digitaria Scop.). Crab-grass.
Syntherisma ischaemum (Schraeb) Nash. (S. linearis, Digitaria humifusa Pers.). Small Crab-grass.
Echinocloa crus-galli (L.) Beauv. Barnyard Grass.
Chaetocloa viridis (L.) Scrib. (Setaria L.). Green Foxtail.
Chaetocloa glauca (L.) Scrib. Yellow Foxtail is doubtless also common, but there is no specimen nor definite record.
Homalocenchrus oryzoides (L.) Pool. (Leersia). Rice Cut-grass. Fide Bigelow.
Homalocenchrus virginicus (Willd.) Britt. (Leersia). Cut-grass. Fide Bigelow.
Zizania aquatica L. (Zizania palustris L. of Gr. Man). Wild Rice. Along the old canal in a pond about a mile above Logan.
Sorghastrum nutans (L.) Nash. Indian-grass. Fide Bigelow.
Andropogon scoparius Mx. Broom Beard-grass.
Andropogon virginicus L. Virginia Beard-grass.
Andropogon furcatus Muhl. Forked Beard-grass.

Subclass, LILIFLORAE.

*Liliales.*

**Liliaceae,** Lily Family.

Subfamily, LILIATAE.

Heamerocallis fulva L. Day-lily.
Allium tricoccum Ait. Wild Leek. No specimen.
Allium canadense L. Meadow Garlic. Fide Bigelow.
Lilium canadense L. Yellow Lily.
Erythronium americanum Ker. Yellow Spring-lily.
Erythronium albidum Nutt. White Spring-lily.

Quamasia hyacinthina (Raf.) Britt. (Camassia esculenta). Wild Hyacinth. Fide Bigelow.
Aletris farinosa L. Colic Root. Fide Bigelow.

Subfamily, MELANTHATAE.

Chamaelirium luteum (L.) Gr. Chamaelirium. Fide Bigelow.
Veratrum woodii Robbins. Wood's False Hellebore. Fide Bigelow. Now known only from Auglaize County.
Uvularia perfoliata L. Perfoliate Bellwort.

Subfamily, TRILLIATAE.

Medeola virginica L. Indian Cucumber-root.
Trillium sessile L. Sessile Wake-robin. No specimen.
Trillium grandiflorum (Mx.) Salisb. Large-flowered Wake-robin.
Trillium erectum L. Ill-scented Wake-robin.

Subfamily, CONVALLARIATAE.

Asparagus officinalis L. Asparagus. Fide Bigelow.
Vagnera racemosa (L.) Morong. (Smilacina). False Spikenard.
Vagnera stellata (L.) Desf. (Smilacina). Stellate Solomon's Seal. Fide Bigelow.
Unifolium canadense (Desf.) Greene (Mianthemum). Wild Lily-of-the-valley.
Polygonatum biflorum (Walt.) Ell. (Salomonia). Common Solomon's Seal. No specimen.
Polygonatum commutatum (R. & S.) Ell. (Salomonia). Large Solomon's Seal.

**Smilacaceae,** Smilax Family.

Smilax herbacea L. Carrion-flower.
Smilax ecirrhata (Englm.) Wats. Upright Smilax.
Smilax glauca Walt. Saw-brier.
Smilax rotundifolia L. Greenbrier.
Smilax hispida Muhl. Hispid Greenbrier. No specimen.

**Pontederiaceae,** Pickerel-weed Family.

Heteranthera dubia (Jacq.) MacM. Water Star-grass. Fide Bigelow.

**Commelinaceae,** Spiderwort Family.

Tradescantia virginica L. Spiderwort.

**Juncaceae,** Rush Family.

Juncus effusus L. Common Rush.
Juncus tenuis Willd. Slender Rush.
Juncus acuminatus Mx. Sharp-fruited Rush.
Juncoides carolinae (Wats.) (Luzula saltuensis Fernald). Hairy Wood-rush. On the edge of its range, known otherwise only in northern Ohio.
Juncoides campestre (L.) Ktze. (Luzula). Common Wood-rush.

**Xyridaceae,** Yellow-eyed Grass Family.

Xyris caroliniana Walt. Fide Bigelow. No specimens known from the state.

*Iridales.*

**Amaryllidaceae,** Amaryllis Family.

Hypoxis hirsuta (L.) Coville. Yellow Star-grass.

**Iridaceae,** Iris Family.

Iris versicolor L. Large Blue Flag. Common in the marshes around Lancaster. No specimen.

Iris cristata Ait. Crested Dwarf Iris. A few stations, especially at the tops of waterfalls, e. g., at the Rock Bridge, in the southern section of the area.

Sisyrinchium graminoides Bick. Blue-eyed Grass. No specimen.

**Dioscoreaceae,** Yam Family.

Dioscorea villosa L. Wild Yam. No specimen.

*Orchidales.*

**Orchidaceae,** Orchid Family.

Fissipes acaulis (Ait.) Sm. (Cypripedium). Stemless Lady-slipper. On the edge of its range, common on the uplands, but not nearly so abundant as in other parts of its range.

Cypripedium reginae Walt. (C. spectabile, C. hirsutum). Showy Lady's-slipper. Fide Bigelow. Almost certainly extinct now.

Cypripedium parviflorum var. pubescens (Willd.) Knight. (C. hirsutum). Yellow Lady's-slipper. Occasional in the Liriodendron forest.

Galeorchis spectabilis (L.) Rydb. (Orchis). Showy Orchid.

Perularia flava (L.) Rydb. (?) Fide Bigelow. Queried by Bigelow.

Lysias orbiculata (Pursh) Rydb. (Habenaria). Large Round-leaf Orchid. Fide Bigelow. Known only from three other counties.

Blephariglottis lacera (Mx.) Farw. (Habenaria). Lacerate Orchid. A few individuals only in Stukey's Swamp. I have not been able to find any since the lumbering of 1912.

Blephariglottis peramoena (Gr.) Rydb. Fringeless Purple Orchid. Occasional in the Liriodendron forest in the southern portion of the area. Not seen around Sugar Grove.

Pogonia ophioglossoides (L.) Ker. Rose Pogonia. Fide Bigelow. Not now known south of Buckeye Lake.

Isotria verticillata (Willd.) Raf. On the edge of its range. Common in the pine woods, but never seen in flower and only once in fruit by the writer.

Limnodorum tuberosum L. (Calopogon puchellus). Only from Buckeye Lake.

Ibidium cernua (L.) House. (Gynostachys, Spiranthes). Nodding Lady's-tresses. Common. No specimen.

Ibidium beckii (Lidl.) House. (Spiranthes simplex). Little Lady's-tresses. A single specimen from near Lancaster, J. E. Hyde. The only Ohio station.

Ibidium gracilis (Biegl) House. (Spiranthes). Slender Lady's-tresses. Unlike most of the orchids, this plant withstands the clearing of the forest very well and is fairly common in pastures and along the road-side.

Peramium pubescens (Willd.) MacM. (Goodyera, Epipactis). Downy Rattlesnake Plantain. Common but restricted to situations not covered with autumn leaves.

Malaxus unifolia Mx. (Microstylis, Achroanthus). Green Adder's-mouth. Inconspicuous but not uncommon. Known in Ohio only from the present area and Wayne County.

Aplectrum spicatum (Walt.) B. S. P. (A. hyemale). Putty Root. Fide Bigelow.

Liparis lilifolia (L.) Rich. (Leptorchis). Large Twayblade.

Corallorhiza odontorhiza (Willd.) Nutt. Small-flowered Coral-root. Rather common in the fall.

Corallorhiza maculata (C. multiflora) Nutt. Large Coral-root.

Class, DICOTYLAE, Dicotyls.

Subclass, THALAMIFLORAE.

*Ranales.*

**Magnoliaceae,** Magnolia Family.

Magnolia acuminata L. Cucumber Tree. Fide Bigelow.

Liriodendron tulipifera L. Tuliptree.

**Annonaceae,** Custard-apple Family.

Asimina triloba (L.) Dunal. Pawpaw. No specimen.

**Ranunculaceae,** Crowfoot Family.

Ranunculus reptans L. (R. flammula var.). Fide Bigelow. Not now known from Ohio.

Ranunculus abortivus L. Kidney-leaf Crowfoot. No specimen.

Ranunculus sceleratus L. Celery-leaf Crowfoot. No specimen.

Ranunculus recurvatus Poir.

Ranunculus acris L. Tall Buttercup. A single plant at the quarry siding, where cars are cleaned, Rockbridge.

Ranunculus pennsylvanicus L. Bristly Buttercup.

Ranunculus septentrionalis Poir. Swamp Buttercup.

Ranunculus hispidus Mx. Hispid Buttercup.

Trollius laxus Salisb. American Globe-flower. Fide Bigelow. Known only from Columbiana and Stark Counties.

Aquilegia canadensis L. Common but not so abundant nor so thrifty as on the limestone cliffs near Columbus.

Delphinium tricorne Mx. Dwarf Larkspur. Not seen within the area itself.

Delphinium carolinianum Walt. (D. azureum). Given by Bigelow. Not otherwise known in Ohio.

Anemone virginiana L. Virginia Anemone.

Anemone canadensis L. Canada Anemone.

Hepatica hepatica (L.) Karst. (H. triloba). Round-lobed Hepatica. Only in the less steep ravines. The change from H. acuta to H. hepatica is very striking as one goes south of our area into Vinton County.

Hepatica acutiloba D. C. (H. acuta.) Sharp-lobed Hepatica. In the deeper canyons. The common form.

Clematis virginiana L. Common Virgin's Bower.

Viorna viorna (L.) Sm. (Clematis). Leather flower.

Caltha palustris L. Marsh Marigold.

Actea alba (L.) Mill. White Baneberry.

Cimucifuga racemosa (L.) Nutt. Black Cohosh. Often a dominant plant in the under herbage around Sugar Grove. Seldom abundant further south.
Isopyrum biternatum (Raf.) T. & G. False Rue anemone. Fide Bigelow. I doubt if this can be found in the area proper. It is conspicuous by its absence.
Syndesemon thalictroides (L.) Hohhm. (Anemonella). Rue Anemone.
Thalictrum dioicum L. Early Meadow-rue.
Thalictrum dasycarpum Fisch. & Lall. (T. purpurascens). Purplish Meadow-rue.
Thalictrum polygamum Muhl. Tall Meadow-rue. No specimen.

**Parnassiaceae,** Grass-of Parnassus Family.

Parnassia caroliniana Mx. Carolina Grass-of-Parnassus. A specimen from Lancaster, J. E. Hyde.

**Ceratophyllaceae,** Hornwort Family.

Ceratophyllum demersum L. Hornwort.

**Berberidaceae,** Barberry Family.

Caulophyllum thalictroides (L.) Mx. Blue Cohosh. No specimen.
Jeffersonia diphylla (L.) Pers. No specimen.
Podophyllum peltatum L. May-apple. No specimen.

**Menispermaceae,** Moonseed Family.

Menispermum canadense L. Moonseed. No specimen.

**Lauraceae,** Laurel Family.

Sassafras sassafras (L.) Karst. (S. officinale). Sassafras.
Benzoin aestivale (Nees.) Spicebush.

*Brassicales.*

**Papaveraceae,** Poppy Family.

Sanguinaria canadensis L. Bloodroot. Strangely absent from most of the southern section, but present in Little Rocky Branch. Common in northern section. No specimen.
Chelidonium majus L. Celendine. No specimen.

**Fumariaceae,** Fumitory Family.

Bicucula cuccularia (L.) Millsp. (Dicentra). Dutchman's Breeches. No specimen.
Bicuccula canadensis (Goldie) Millsp. (Dicentra). Squirrel Corn. No specimen.
Capnoides sempervirens (L.) Borck. (Corydalis). Pink Corydalis.

**Brassicaceae,** Mustard Family.

Draba verna L. Vernal Whitlaw-grass. No specimen.
Camelina sativa (L.) Krantz. Common Toad-flax. Fide Bigelow.
Bursa bursa-pastoris (L.) Britt. (Capsella). Shepherd's Purse. No specimen.
Armoracia armoracia (L.) Britt. (Roripa). Horseradish.
Radicula palustris (L.) Moench. Marsh Yellow Cress.
Lepidium virginicum L. Pepper-grass.
Cheirinia cheiranthoides (L.) Link. Worm-seed Mustard. Fide Bigelow.
Erysimum officinale L. (Sisybrium). Hedge Mustard. No specimen.

Barbarea barbarea (L.) MacM. (B. vulgaris). Winter Cress. No specimen.
Arabis hirsuta (L.) Scop. Hairy Rock-cress.
Arabis laevigata (Muhl.) Torr. Smooth Rock-cress.
Arabis canadensis L. Sickle Pod. Fide Bigelow.
Arabis glabra (L.) Bernh. Tower Mustard. Fide Bigelow.
Cardamine hirsuta L. Hairy Bitter-cress.
Cardamine pennsylvanica Muhl. Pennsylvania Bitter-cress.
Cardamine parviflora L. Small-flowered Bitter-cress.
Cardamine bulbosa (Schreb.) B. S. P. Bulbous Bitter-cress.
Cardamine rotundifolia Mx. Round-leaf Bitter-cress. Fide Bigelow. Now known only from Belmont and Noble counties.
Dentaria laciniata Muhl. Cut-leaf Toothwort.
Dentaria diphylla Mx. Two-leaf Toothwort. At the head of Laurel Run and in one or two other stations.
Dentaria heterophylla Nutt. Common in the deep canyons of the southern half of the area. Not around Sugar Grove.
Brassica nigra (L.) Koch. Black Mustard.

*Geraniales.*

**Geraniaceae,** Geranium Family.

Geranium maculatum L. Wild Geranium.
Geranium carolinianum L. Carolina Crane's-bill. Fide Bigelow.

**Oxalidaceae,** Wood-sorrel Family.

Oxalis corniculata L. No specimen.
Oxalis cymosa Small.
Oxalis grandis Small.
Oxalis violacea L. No specimen.

**Limnanthaceae,** False-Mermaid Family.

Floerkia proserpinacoides Willd. False-Mermaid. Fide Bigelow.

**Linaceae,** Flax Family.

Linum virginianum L. Yellow Flax.

**Balsamiaceae,** Jewelweed Family.

Impatiens biflora Walt. Spotted Jewelweed. No specimen.
Impatiens pallida Nutt. (I. aurea). Yellow Jewelweed. No specimen.

**Rutaceae,** Rue Family.

Xanthoxylum americanum Mill. Prickly Ash. Fide Bigelow.

**Simarubaceae,** Ailanthus Family.

Ailanthus glandulosa Desf. Tree-of-Heaven. No specimen.

**Polygalaceae,** Milkwort Family.

Polygala verticillata L. Whorled Milkwort.
Polygala ambigua Nutt. Loose-spike Milkwort.
Polygala viridescens L. Purple Milkwort.

Polygala senega L. Seneca Snakeroot. Fide Bigelow.

Polygala incarnata L. Pink Milkwort. Fide Bigelow. No authentic specimens are now known from Ohio.

**Euphorbiaceae,** Spurge Family.

Acalypha virginica L. Virginia Three-seeded Mercury.

Acalypha graciliens Gr. Slender Three-seeded Mercury.

Titythymalus lathrus (L.) Hill. (Euphorbia). Caper Spurge. Known from Hocking County only.

Titythymalus obtusatus (Pursh) K. & G. Blunt-leaf Spurge. Fide Bigelow.

Titythymalopsis corallata (L.) K. & G. (Euphorbia). Flowering Spurge.

Chamaesyce preslii (Guss) Arth. (Euphorbia nutans). Nodding Spurge.

Chamaesyce maculata (L.) Small. (Euphorbia). Milk Spurge.

**Callitrichaceae,** Water Starwort Family.

Callitriche sp. Fide Bigelow.

*Malvales.*

**Malvaceae,** Mallow Family.

Abutilon abutilon (L.) Rusby (A. theophrasti Medic.). Velvet Leaf. Common. No specimen.

Malva rotundifolia L. Low Mallow. No specimen.

Napaea dioica L. Glade Mallow.

Sida spinosa L. Prickly Sida. No specimen.

Hibiscus militaris Cav. Fide Bigelow.

**Tiliaceae,** Linden Family.

Tilia americana L. Basswood.

*Guttiferales.*

**Hypericaceae,** St. John's-wort Family.

Ascron hypericoides L. St. Andrew's Cross.

Hypericum ascyron L. Fide Bigelow.

Hypericum prolificum L. Shrubby St. John's-wort.

Hypericum punctatum Lom. (H. maculatum). Spotted St. John's-wort. Fide Bigelow.

Hypericum mutilum L. Dwarf S. John's-wort.

Hypericum drummundii (Grev. & Hook.) T. & G. Drummond's St. John's-wort. A single station on the top of the cliff overlooking the junction of "The Gulf" with the Canyon of Clear Creek, fairly numerous in 1909, less so in 1910 and 1911. The extreme eastern edge of its range.

Sarothra gentianoides L. Orange Grass. Fide Bigelow.

**Cistaceae,** Rock-rose Family.

Crocanthemum majus (L.) Britt. (Helianthemum). Hoary Frost-weed.

Lechea minor L. Thyme-leaf Pinweed.

Lechea racemubosa Mx. Oblong-fruited Pinweed.

**Violaceae,** Violet Family.

Cubelium concolor (Forst.) Raf. (Hybanthus). Green Violet.

Viola canadensis L. Canada Violet.

Viola pubescens Ait. Hairy Yellow Violet.

Viola striata Ait. Striped White Violet.

Viola rostrata Pursh. Long-spurred Violet. Common. No specimen.

Viola rotundifolia Mx. Round-leaf Yellow Violet. Collected by Kellerman near the Rock House, but seen by the writer only in Little Rocky Branch.

Viola pallens (Banks) Brain. (V. lecontiana). Woodland White Violet.

Viola blanda Willd. Sweet White Violet.

Viola lanceolata L. Lance-leaf Violet. A single plant, collected at Sugar Grove by Miss Lied.

Viola affinis Le C. (V. obliqua). Thin-leaf Violet.

Viola papilionacea Pursh. Common Blue Violet.

Viola hirsutula Brainerd. Southern Wood Violet. Not collected from any other area of the state.

Viola palmata L. Early Blue Violet.

**Passifloraceae,** Passion-flower Family.

Passiflora lutea L. Yellow Passion-flower. Fairly common, but does not flower freely; on the northern edge of its range.

Subclass, CENTROSPERMAE.

*Caryophyllales.*

**Caryophyllaceae,** Pink Family.

Subfamily, ALSINATAE.

Alsine media L. (Stellaria). Common Chickweed. No specimen.

Alsine pubera (Mx.) Britt. (Stellaria). Great Chickweed.

Alsine longiflora (Muhl.) Britt. (Stellaria). Long-leaf Stichwort. No specimen.

Cerastium viscosum L. Mouse-ear Chickweed. Fide Bigelow.

Cerastium vulgatum L. Larger Mouse-ear Chickweed.

Cerastium longipedunculatum Muhl. (C. nutans). Nodding Chickweed. Fide Bigelow.

Arenaria seppyllifolia L. Thyme-leaf Sandwort.

Spergula arvensis L. (?) Fide Bigelow. (Queried by Bigelow.) Now known only from Lake County.

Subfamily, CARYOPHYLLATAE.

Agrostema githago L. Corn Cockle.

Silene stellata (L.) Ait. Starry Campion.

Silene virginica L. Fire Pink.

Silene rotundifolia Nutt. Round-leaf Catchfly. Known only from Hocking and Jackson Counties. Common on the cliffs in the southern portion of the area up to Cantwell Cliffs, which is, so far as I have found, the northernmost limit of its range; entirely lacking around Sugar Grove.

Silene antirrhina L. Sleepy Catchfly.

Silene noctiflora L. Fide Bigelow.

Lychnis coronaria (L.) Desv. Mullein Pink.

Saponaria officinalis L. Bouncing Bet.

**Aizoaceae,** Carpetweed Family.

Mullugo verticillata L. Carpetweed.

**Portulacaceae,** Portulaca Family.

Claytonia virginica L. Spring Beauty. No specimen.
Portulaca oleracea L. Purslane. No specimen.

**Phytolaccaceae,** Pokeweed Family.

Phytolacca americana L. (P. decandra). Pokeweed. Common. No specimen.

*Chenopodiales.*

**Corrigiolaceae,** Whitlow-wort Family.

Anychia canadensis (L.) B. S. P. No specimen.

**Amaranthaceae,** Amaranth Family.

Amaranthus retroflexus L. Rough Pigweed.
Amaranthus hybridus L. Fide Bigelow.

**Chenopodiaceae,** Goosefoot Family.

Chenopodium album L. Lamb's-quarters. No specimen.
Chenopodium hybridum L. Maple-leaf Goosefoot.
Chenopodium ambrosoides L. Mexican Tea.
Chenopodium botrys L. Fide Bigelow.

*Polygonales.*

**Polygonaceae,** Buckwheat Family.

Rumex acetosella L. Sheep Sorrel. Common. No specimen.
Rumex verticillatus L. Swamp Dock. Fide Bigelow.
Rumex altissimus Wood. Tall Dock.
Rumex britannica L. Great Water Dock. Old canal, about a mile above Logan.
Rumex crispus L. Curly Dock.
Rumex obtusifolius L. Broad-leaf Dock. Common. No specimen.
Tiniaria convolvulus (L.) W. & M. Black Bindweed. Fide Bigelow.
Tiniaria scandens (L.) Sm. Climbing False Buckwheat. No specimen.
Tracaulon sagitatum (L.) Sm. Arrow-leaf Tear-thumb.
Tracaulon arifolium (L.) Raf. Halberd-leaf Tear-thumb. In a few stations around Sugar Grove, the edge of its range.
Fagopyrum fagapyrum (L.) Karst. (F. esculentum). Buckwheat. Commonly escaped. No specimens.
Persicaria amphibia (L.) S. F. G. (Polygonum). Water Knotweed.
Persicaria pennsylvanica (L.) Sm. Pennsylvania Knotweed. Abundant. No specimen.
Persicaria persicaria (L.) Sm. Lady's Thumb.
Persicaria hydropiperoides (Mx.) Sm. Mild Smartweed.
Persicaria punctata (Ell.) Sm. (P. acre). Water Smartweed.
Persicaria orientalis (L.) Spach. Prince's Feather.
Tovaria virginiana (L.) Raf. (Polygonum). Virginia Knotweed.
Polygonum aviculare L. Doorweed. No specimen.

Polygonum erectum L. Erect Knotweed.
Polygonum tenue Mx. Slender Knotweed. Fide Bigelow.

*Piperales.*

**Saururaceae,** Lizard's-tail Family.

Saururus cernuus L. Lizard's Tail.

Subclass, CALYCIFLORAE.

*Rosales.*

**Rosaceae,** Rose Family.

Subfamily, ROSATAE.

Geum vernum (Raf.) T. & G. Spring Avens. No specimen.
Geum canadense Jacq. White Avens. No specimen.
Geum strictum Ait. Yellow Avens.
Dasyphora fruitcosa (L.) Rydb. Shrubby Cinquefoil. Fide Bigelow. Almost certainly extinct at present.
Potentilla canadensis L. Common Five-finger. No specimen.
Potentilla monspeliensis L. Rough Cinquefoil.
Potentilla recta L. Upright Cinquefoil.
Waldsteinia fragarioides (Mx.) Tratt. Barren Strawberry. Fide Bigelow. Certainly very rare.
Fragaria virginiana Duchesne. Virginia Strawberry.
Fragaria vesca americana Porter. American Wood Strawberry. No specimen.
Fragaria vesca L. (White-fruited variety.) In the lower part of Kunkle's Hollow.
Rubus odoratus L. Purple Flowering Raspberry.
Rubus triflorus Rich. (R. americanus). Dwarf Raspberry.
Rubus occidentalis L. Black Raspberry. Common; as is also the forma *pallidus*, with amber fruit. No specimens.
Rubus allegheniensis Port. High Bush Blackberry. Has also recently been called Rubus villosus, R. canadensis, and R. nigrobaccus.
Rubus procumbus Muhl. Dewberry. Has also been known recently as R. canadensis, and R. villosus.
Porteranthus stipulatus (Muhl) Britt. (Gillenia). American Ipecac. Fide Bigelow.
Filipendula rubra (Hill) Rob. (Ulmaria). Queen-of-the-Prairie. Fide Bigelow.
Opulaster opulifolius (L.) Ktze. (Physcocarpus). Nine Bark. Fide Bigelow.
Spiraea alba Du Roi. (S. salicifolia). Narrow-leaf Spiraea. Fide Bigelow.
Spiraea tomentosa L. Hardhack.
Aruncus aruncus (L.) Karst. (A. sylvester). Goat's Beard.
Rosa setigera Mx. Prairie Rose.
Rosa carolina L. Swamp Rose.
Rosa virginiana Mill. (R. humilis). Low Rose.
Rosa rubiginosa L. Sweetbrier (Rose). Fide Bigelow.
Agrimonia gryposepala Wallr. Common Agrimony. Fide Bigelow.
Agrimonia parviflora Soland. Small-flowered Agrimony.
Sanguisorba canadensis L. American Burnet. Fide Bigelow.

Subfamily, MALATAE.

Malus coronaria (L.) Mill. (Pyrus angustifolia). Narrow-leaf Crab-apple.

Malus glaucescens Rehd. (P. coronaria). American Crab-apple.

Malus malus (L.) Britt. (Pyrus). Common Apple.

Aronia melanocarpa (Mx.) Britt. (Pyrus, A. nigra). Black Chokeberry. Not uncommon among the Huckleberries.

Amalanchier canadensis (L.) Med. Service Berry Shad Bush.

Amalanchier botryapium (L. f.) T. & G. Fide Bigelow.

Crategus crus-galli L. Cockspur Thorn. No specimen.

Crategus punctata Jacq. Large fruited Thorn.

Crategus coccinea L. Scarlet Thorn.

Crategus succulenta Schred. (C. macrocantha). Long-spine Thorn.

Subfamily AMYGDALATAE.

Prunus virginiana L. (P. serotina, Padus) Wild Black Cherry.

Prunus nana Du Roi. (P. virginiana, Padus) Choke Cherry.

Prunus americana Marsh. Wild Plum.

Amygdalus persica L. Peach.

**Fabaceae,** Pea Family.

Subfamily, CASSIATAE.

Cercis canadensis L. Redbud. Common all around the area and in the northern section but very rare in the southern section. A satisfactory hypothesis to account for this and some similar anomalies is beyond the imagination of the writer, but the absence of the redbud is exceedingly striking in the spring, when a single flowering tree can be seen for miles, so that there can be no question of the fact. No specimens.

Chamaechrista nictitans (L.) Moench. Sensitive Pea.

Chamaechrista fascicultata (Mx.) Greene. (Cassia Chamaechrista). Partridge Pea.

Cassia marylandica L. Wild Senna.

Gleditschia tricanthos L. Honey Locust.

Gymnocladus dioica (L.) Koch. Coffee-bean. This species reaches the edge of its range immediately to the west of the Sugar Grove area. After some search a single tree was found close by the Leaning Rock on the Clear Creek Road. No specimen.

Subfamily, FABATAE.

Baptisia tinctoria (L.) R. Br. Blue Wild-indigo. Fide Bigelow.

Baptisia leucantha T. & G. Large White Wild-indigo. Fide Bigelow.

Melilotus alba Desv. White Sweet-clover.

Trifolium procumbens L. Low Hop-clover.

Trifolium pratense L. Red Clover. No specimen.

Trifolium reflexum L. Buffalo Clover. Fide Bigelow. Known only from Lawrence County.

Trifolium hybridum L. Alsike Clover.

Trifolium repens L. White Clover. No specimen.

Psoralea onobrychis Nutt. Fide Bigelow.

Cracca virginiana L. (Tephrosia) Goat's-rue.

Robinia pseudacacia L. Black Locust. No specimen.

Robinia viscosa Vent. Clammy Locust.

Astragalus carolinianus L. Carolina Milk-vetch. No specimen.

Stylosanthes biflora (L.) B. S. P. (S. elatior). Pencil Flower. A few specimens on Queer Creek. Also recorded for Fairfield County by Bigelow. The northern edge of its range.

Meibomia nudiflora (Desmodium) (L.) Ktze. Naked-flowered Tick-trefoil.

Meibomia grandiflora (L.) Ktze. (Desmodium). Pointed-leaf Tick-trefoil. Fide Bigelow.

Meibomia michauxii Vail (Desmodium rotundifolium). Prostrate Tick-trefoil.

Meibomia canescens (L.) Ktze. (Desmodium). Hoary Tick-trefoil.

Meibomia bracteosa (Mx.) Ktze. (Desmodium cuspidatum). Large-bracted Tick-trefoil. Queer Creek Valley. No specimen.

Meibomia paniculata (L.) Ktze. (Desmodium) Panicled Tick-trefoil.

Meibomia viridiflora (L.) Ktze. (Desmodium) Velvet-leaf tick-trefoil.

Meibomia dillenii (Darl.) Ktze. Desmodium) Dillen's Tick-trefoil.

Meibomia canadensis (L.) Ktze. (Desmodium) Canadian Tick-trefoil. Fide Bigelow.

Meibomia rigida (Ell.) Ktze. (Desmodium) Rigid Tick-trefoil. Known from Fairfield and Paulding Cos. only.

Meibomia marylandica (L.) Ktze. (Desmodium) Maryland Tick-trefoil. Known only from Fairfield and Hocking Counties.

Meibomia obtusa (Muhl.) Vail. (Desmodium ciliare). Ciliate Tick-trefoil. Old fields e. g. above Stukey's swamp; no specimen.

Lespedeza repens (L.) Bart. Creeping Bush-clover.

Lespedeza procumbens Mx. Trailing Bush-clover.

Lespedeza violacaea (L.) Pers. Violet Bush-clover.

Lespedeza frutescens (L.) Britt.

Lespedeza hirta (L.) Ell. Hairy Bush-clover.

Lespedeza capitata Mx. Round-headed Bush-clover.

Vicia caroliniana Walt. Carolina Vetch. No specimen.

Lathrus palustris L. Marsh Vetchling. Fide Bigelow.

Falcata comosa (L.) Ktze. (Amphicarpea monica). Hog Peanut.

Glycine apios (L.) MacM. (Apios tuberosa). Ground Nut. No specimen.

Strophostyles helvola (L.) Britt. Trailing Wild-Bean.

*Saxifragales.*

**Crassulaceae,** Orpine Family.

Sedum ternatum Mx. Wild Stonecrop.

Penthorum sedoides L. Ditch Stonecrop.

**Saxifragaceae,** Saxifrage Family.

Micranthes pennsylvanica L. (Haw) (Saxifraga) Swamp Saxifrage. Near the pumping station N. E. of Sugar Grove. No specimen.

Micranthes virginiensis (Mx.) Sm. Early Saxifarge.

Sullivantia sullivantii (T. & G.) Britt. Sullivantia. Abundant on dripping cliffs under waterfalls in the southern section of the area. Absent north of Cantwell Cliffs.

Tiarella cordifolia L. False Miterwort. Abundant and often the dominant underherb of the deep forest in the southern section of the area, but never seen around Sugar Grove. It is incomprehensible to me how such an abundant plant can drop out so completely in so short a distance under conditions apparently so nearly uniform. No specimen.

Heuchera americana L. Alum-root.

Mitella diphylla L. Bishop's Cap.

Chrysosplenium americanum Schw. Golden Saxifrage.

*Thymelales.*

**Lythraceae,** Loosestrife Family.

Decodon verticillatus (L.) Ell. Water Willow. Only from Buckeye Lake.

Parsonsia petiolata (L.) Rusby. (Cuphea viscosissima Jacq.). Tar-weed.

**Thymelaceae,** Mezereum Family.

Dirca palustris L. Leatherwood. Cantwell Cliffs. No specimen.

*Celastrales.*

**Rhamnaceae,** Buckthorn Family.

Rhamnus lanceolata Pursch. Lanceleaf Buckthorn. Fide Bigelow.

Rhamnus caroliniana Walt. Carolina Buckthorn. A specimen was collected and determined in the field as R. caroliniana by the writer on Big Pine Creek June 20, 1911, but it was not preserved. The only specimen in state herbarium is from Adams Co.

Ceonothus americanus L. New Jersey Tea.

**Vitaceae,** Vine Family.

Vitis aestivalis Mx. Summer Grape.

Vitis bicolor LeConte. Blue Grape.

Vitis cordifolia Mx. Frost Grape. Fide Bigelow.

Parthenocissus quinquefolia (L.) Planch. (Psedera). Virginia Creeper. No specimen.

**Celastraceae,** Staff-tree Family.

Euonymus obovatus Nutt. Running Strawberry-bush. No specimen.

Euonymus atropurpureus Jacq. Wahoo. Fide Bigelow.

Celastrus scandens L. Climbing Bitter-sweet.

**Ilicaceae,** Holly Family.

Ilex verticillata (L.) Gr. Fever Bush.

**Staphyleaceae,** Bladdernut Family.

Staphylea trifolia L. American Bladdernut. No specimen.

*Sapindales.*

**Aesculaceae,** Buckeye Family.

Aesculus glabra Willd. Ohio Buckeye. No Specimen.

Aesculus octandra Marsh. Sweet Buckeye.

**Aceraceae,** Maple Family.

Acer spicatum Lam. Mountain Maple. Was reported by Bigelow. It is unknown to the writer.

Acer saccharinum L. Silver Maple. No specimen.

Acer rubrum L. Red Maple. Common on both uplands and lowlands.

Acer saccharum Marsh. Sugar Maple.

Acer nigrum Mx. Black Sugar Maple.

Acer negundo L. Box Elder.

**Anacardiaceae,** Sumac Family.

Rhus copallina L. Upland Sumac.

Rhus hirta (L.) Sudw. (R. typhina). Staghorn Sumac.

Rhus glabra L. Smooth Sumac.

Toxicodendron vernix (L.) Ktz. (Rhus) Poison Sumac. A single individual along the road near the center of section 4, Berne Twp., the extreme southern limit of the species. Reported by Bigelow without comment. Undoubtedly once far more plentiful than now.

Toxicodendron radicans (L.) Ktz. (Rhus) Poison Ivy. No specimen.

Subclass, AMENTIFERAE.

*Platanales.*

**Hamamelidaceae,** Witch-hazel Family.

Hamamelis virginiana L. Witch-hazel.

**Platanaceae,** Planetree Family.

Platanus occidentalis L. Sycamore. On uplands as well as lowlands where the light is sufficiently intense.

*Urticales.*

**Ulmaceae,** Elm Family.

Ulmus americana L. White Elm.

Ulmus fulva Mx. Slippery Elm.

Celtis occidentalis L. Hackberry.

**Moraceae,** Mulberry Family.

Morus rubra L. Red Mulberry.

Humulus lupulus L. Hop.

Cannabis sativa L. Hemp. Fide Bigelow.

**Urticaceae,** Nettle Family.

Urtica gracilis L. Slender Nettle. No specimen.

Urticastrum divaricatum (L.) Ktze. (Laportea canadansis (L.) Gaud.) Wood Nettle, Common. No specimen.

Pilea pumila (L.) Raf. (Adicea). Clear Weed. Common. No specimen.

Boehmeria cylindrica (L.) Sw. False Nettle. No specimen.

Parietaria pennsylvanica Muhl. Abundant. No specimen.

*Fagales.*

**Fagaceae,** Beech Family.

Fagus grandifolia Ehrh. American Beech.
Castanea dentata (Marsh.) Borkh. Chestnut.
Quercus alba L. White Oak.
Quercus stellata Wang. (Q. minor). Post Oak. Not common.
Quercus macrocarpa Mx. Bur Oak.
Quercus bicolor Willd. (Q. platanoides) Swamp White Oak.
Quercus prinus L. Rock Chestnut Oak.
Quercus imbricaria Mx. Shingle Oak.
Quercus velutina Lam. Black Oak.
Quercus coccinea Wang. Scarlet Oak.
Quercus rubra L. Red Oak.
Quercus palustris DuRoi. Pin Oak.

**Betulaceae,** Birch Family.

Carpinus caroliniana Walt. Blue Beech.
Ostrya virginiana (Mill.) Willd. Hop Hornbeam. Must occur at least on the western borders of the area but is not common and was not found after some little search by the writer.
Corylus americana Walt. Hazlenut. Common, no specimen.
Betula nigra L. Red Birch. Common on Queer Creek and some other streams in the southern portion of the area. Absent from the northern portion. Not known to the northward in Ohio.
Betula lenta L. Sweet Birch. Common throughout the area.
Betula lutea Mx. f. Yellow Birch. Common in the deep canyons of the southern half of the area, but altogether lacking in the northern section. Otherwise unknown south of Wayne and Summit Counties.
Alnus rugosa (DuRoi) Koch. Smooth Alder.

**Juglandaceae,** Walnut Family.

Hicoria cordiformis (Wang.) Britt. (Carya, H. minima) Bitternut.
Hicoria ovata (Mill.) Britt. (Carya) Shagbark (Hicory).
Hicoria laciniosa (Mx. f.) Sarg. (Carya) Not uncommon, no specimens.
Hicoria alba (L.) Britt. (Carya) Mockernut.
Hicoria microcarpa (Nutt.) Britt. (Carya) Small pignut.
Juglans nigra L. Black Walnut. Common along the Hocking Bottom; altogether lacking through most of the area.
Juglans cinerea L. Butternut. Common except on the richest land.

*Salicales.*

**Salicaceae,** Willow Family.

Populus alba L. Silver Poplar.
Populus balsamifera candicans (Ait.) Gr. Balm-of-Gilead.
Populus grandidentata Mx. Large-tooth Poplar.
Populus tremuloides Mx. American Aspen.
Populus deltoides Marsh. Cottonwood.

Salix nigra Marsh. Black Willow.
Salix fragilis L. Crack Willow.
Salix alba L. White Willow.
Salix alba vitellina (L.) Koch. Golden Osier.
Salix babylonica L. Weeping Willow. A single specimen along the river south of Sugar Grove, apparently not planted, now long dead. This species does not establish itself in Ohio.
Salix interior Rowlee (S. fluviatilis, S. longifolia). Sandbar Willow.
Salix discolor Muhl. Pussy Willow.
Salix discolor X humilis.
Salix humilis Marsh. Upland Willow.
Salix sericea Marsh. Silky Willow.
Salix cordata Muhl. Heart-leaf Willow.

Subclass MYRTIFLORAE.

*Myrtales.*

**Hydrangeaceae,** Hydrangea Family.

Hydrangea arborescens L. Wild Hydrangea.

**Grossulariaceae,** Gooseberry Family.

Grossularia cynosbati (L.) Mill. Wild Gooseberry.
Ribes odoratum Wendl. Golden Currant.

**Onagaraceae,** Evening Primrose Family.

Isnardia pulustris L. (Ludwigia) Marsh Purslane. No specimen.
Ludwigia polycarpa, Short & Peter. Many fruited Ludwigia. No specimen.
Ludwigia alternifoila L. Seedbox.
Epilobium coloratum Muhl. Purple Willow-herb.
Oenothera biennis (L.) Scop. Evening Primrose.
Kneiffia pumila (L.) Spach. (Oenothera). Small Sundrops.
Gaura biennis L. No specimen.
Circaea lutetiana L. Common enchanter's Nightshade.
Circaea alpina L. Small enchanter's Nightshade. Common in the caves of the southern section, not found around Sugar Grove. On the edge of its range.

**Haloragidaceae,** Water Milfoil Family.

Myriophyllum spicatum L. Spiked Water-milfoil. From Buckeye Lake.

*Loascales.*

**Cucurbitaceae,** Pumpkin Family.

Micrampelis lobata (Mx.) Greene. Wild Cucumber.
Sicyos angulatus L. Star Cucumber.

*Aristolochiales.*

**Aristolochiaceae,** Birthwort Family.

Asarum canadense L. Wild-ginger.
Asarum reflexum Bicknell. Short-lobed Wild-ginger.
Aristolochia serpentaria L. Virginia Snakeroot.

*Santalales.*

**Santalaceae,** Sandalwood Family.

Comandra umbellata (L.) Nutt. Bastard Toad-flax.

Subclass HETEROMERAE.

*Primulales.*

**Primulaceae,** Primrose Family.

Samolus floribundus H. B. K. Water Pimpernel.

Lysimachia quadrifolia L. Whorled Loosestrife.

Lysimachia terristris (L.) B. S. P. Fide Bigelow.

Lysimachia mumularia L. Moneywort. No specimen.

Steironema ciliatum (L.) Raf. Fringed yellow Loosestrife.

Steironema lanceolatum (Walt) Gr. Fide Bigelow.

Steironema quadiflorum (Sims) Hitch.

Naumbergia thyrsiflora (L.) Duby. Fide Bigelow.

Anagalis arvensis L. Scarlet Pimpernel.

Dodecatheon meadia L. Shooting Star. Several patches found on the cliffs on the west side of "The Gulf." Also reported by Bigelow for Fairfield Co.

*Ericales.*

**Pyrolaceae,** Wintergreen Family.

Pyrola americana Sw. Round-leaf Wintergreen. Scarce.

Pyrola elliptica Nutt. Shinleaf Wintergreen. The common form.

Chimaphila maculata (L.) Pursh. Spotted Pipsisewa.

**Monotropaceae,** Indian-pipe Family.

Monotropa uniflora L. Indian-pipe.

Hypopytis americana (D. C.) Small Pinesap.

**Ericaceae,** Heath Family.

Azalea lutea L. (Rhododendron calendulaceum) Flame Azalea. Common on a few hillsides in the immediate vicinity of Sugar Grove. The only station in the state. Persistent and long continued search for it in the southern section of the area during its flowering season has failed to reveal it. It is in imminent danger of extinction and should be protected.

Rhododendron maximum L. Rhododendron. Abundant in the northern section of the area from Clark's Crossing to Sugar Grove and a little beyond. Also at the "Written Rock" on Clear Creek and near the head of Laurel Run. Otherwise absent from the southern section although there are multitudes of habitats apparently more suitable for it than those in which it has been found.

Kalmia angustifolia L. Sheep Laurel. I have been informed by trustworthy observers that this plant formerly grew in the area and have been directed to one of its habitats, namely the head of Laurel Run, but I have not found it. Neither was it known to Bigelow or Sullivant, nor is there an authentic specimen from Ohio.

Oxydendrum arboreum (L.) DC. Sorrel-tree. On the edge of its range. Common.

Epigaea repens L. Trailing arbutus. Common.

Gaultheria procumbens L. Creeping Wintergreen.

**Vacciniaceae,** Huckleberry Family.

Gaylussacia baccata (Wang.) Koch. (G. resinosa) Huckleberry.
Polycodium stamineum (L.) Greene. Deerberry.
Vaccinium angustifolium Ait. Dwarf Blueberry.
Vaccinium vacillans Kalm. Low Blueberry.
Oxycoccus macrocarpus (Ait.) Pers. (Vaccinium) Cranberry. Fide Bigelow, doubtless only in Buckeye Lake.

*Ebenales.*

**Ebenaceae,** Ebony Family.

Diospyros virginiana L. Persimmon. Abundant but does not fruit freely.

Subclass TUBIFLORAE.

*Polemoniales.*

**Polemoniaceae,** Phlox Family.

Phlox paniculata L. Garden Phlox.
Phlox maculata L. Spotted Phlox.
Phlox divaricata L. Wild Sweet-william.
Phlox stolonifera Sims. (P. reptans) Creeping Phlox. Not uncommon in the deepest ravines of the southern section of the area. The only Ohio stations.
Phlox subulata L. Ground Phlox.
Polemonium reptans L. Greek Valerian. No specimen.

**Convolvulaceae,** Morning-glory Family.

Ipomoea pandurata (L.) Meyer. Wild Potato-vine.
Ipomoea purpurea (L.) Roth. Common Morning-glory. No specimen.
Convolvulus sepium L. Hedge Bindweed.

**Cuscutaceae,** Dodder Family.

Cuscuta coryli Englem. Hazel Dodder.
Cuscuta gronovii Willd. Gronovius's Dodder.

**Hydrophyllaceae,** Water-leaf Family.

Hydrophyllum virginianum L. Virginia Water-leaf. Fide Bigelow.
Hydrophyllum macrophyllum Nutt. Large-leaf Water-leaf.
Hydrophyllum appendiculatum Mx. Appendaged Water-leaf. No specimen.
Hydrophyllum canadense L. Broad-leaf Water-leaf. No specimen.
Phacelia dubia (L.) Small. Small-flowered Phacelia. On the ridge west of Clark's Crossing and a few other localities, the only Ohio stations.
Phacelia purshii Buckl. Pursh's Phacelia. In the Hocking Bottom at Sugar Grove. No specimen.

*Gentianales.*

**Oleaceae,** Olive Family.

[Fraxinus quadrangulata Mx.] Blue Ash. Apparently reaches the eastern edge of its range just west of the present area. It is common about Columbus, but has not been seen around Sugar Grove.
Fraxinus pennsylvanica Marsh. Red Ash.

Fraxinus lanceolata Borck. Green Ash.
Fraxinus americana L. White Ash.

**Gentianaceae,** Gentian Family.

Sabbatia angularis (L.) Pursh. Square Stemmed Sabbattia.
Gentiana crinita Froel. Fringed Gentian. Fide Bigelow.
Gentiana quinquefolia L. Stiff Gentian. Fide Bigelow.
Gentiana saponaria L. (Dasystephana) Soapwort Gentian. Fide Bigelow.
Gentiana andrewsii Griseb. Closed Gentian.
Frasera carolinensis Walt. American Columbo. Fide Bigelow.
Oblaria virginica L. Pennywort.

**Apocynaceae,** Dogbane Family.

Apocynum androsaemifolium L. Spreading Dogbane.
Apocynum cannabinum L. Indian Hemp.

**Asclepiadaceae,** Milkweed Family.

Asclepias tuberosa L. Buterfly weed. Occasional. No specimen.
Asclepias purpurascens L. Purple Milkweed. Fide Bigelow.
Asclepias incarnata L. Swamp Milkweed.
Asclepias sullivantii Engelm. Rare. Known otherwise only from Erie Co.
Asclepias amplexicaulis Sm. Blunt leaved Milkweed. Rare. Collected on the ridge west of Clark's Crossing. Known otherwise only from Erie County.
Asclepias exaltata (L.) Muhl. (A. phytolaccoides) Tall Milkweed.
Asclepias variegata L. White Milkweed. Collected once on Big Pine Creek by B. W. Wells and the writer. Known otherwise in Ohio only from Summit Co. Also reported by Bigelow for Fairfield Co.
Asclepias quadrifolia L. Four-leafed Milkweed.
Asclepias syriaca L. Common Milkweed.
Asclepias verticillata L. Whorled Milkweed. Kettle Hills, W. A. Kellerman. Rare.

*Scrophulariales.*

**Solanaceae,** Potato Family.

Datura stramoniumium L. Jimson-weed. No specimen.
Physalis pubescens L. Low hairy Ground-cherry. No specimen.
Physalis lanceolata Mx.
Physalis virginiana Mill. Fide Bigelow.
Physalis heterophylla Nees.
Lycopersicon lysopersicon (L.) Karst. (L. esculentum) Tomato.
Solanum tuberosum L. Potato.
Solanum nigrum L. Black Nightshade.
Solanum caroliniense L. Horse nettle. Bigelow cites this now troublesome weed as collected exclusively by A. Hor of Baltimore, Ohio. Apparently it had just appeared in 1841. No specimen.

**Scrophulariaceae,** Figwort Family.

Verbascum thapsus L. Common Mullein.
Verbascum blattaria L. Moth Mullein.

Linaria linaria (L.) Karst. (L. vulgaris) Butter and Eggs.
Scrophularia marylandica L. Maryland Figwort. No specimen.
Chelone glabra L. Turtle-head.
Penstemon hirsutus (L.) Willd. Hairy Beard-tongue. No specimen.
Penstemon penstemon (L.) Britt. (P. leavigatus) Smooth Beard-tongue. No specimen.
Collinsia verna Nutt. Blue-eyed Mary. Fide Bigelow.
Mimulus ringens L. Square-stemmed Monkey Flower.
Mimulus alatus Soland. Winged Monkey-flower.
Gratiola virginica L. Clammy Hedge-hyssop.
Ilysanthes dubia (L.) Barnh. Long Stalked False Pimpernel.
Veronica anagalis-aquatica L. Water Speedwell. Fide Bigelow.
Veronica scutellata L. Skullcap Speedwell. Fide Bigelow.
Veronica officinalis L. Common Speedwell.
Veronica serpyllifolia L. Thyme-leaf Speedwell. Fide Bigelow.
Veronica peregrina L. Purslane Speedwell.
Veronica arvensis L. Field Speedwell.
Leptandra virginica (L.) Nutt. (Veronica) Culver's Root.
Afzelia macrophylla (Nutt.) Ktze. (Seymeria) Mullein Foxglove. Written Rock, Clear Creek, W. A. Kellerman. Not seen within the area by the writer, but a few plants were found in Vinton County about a mile below the Queer Creek Divide. On the edge of its range.
Dasystoma flava (L.) Wood (Gerardia) Downy False Foxglove.
Dasystoma laevigata Raf. (Gerardia) Entire-leaf False Foxglove.
Dasystoma virginica (L.) Britt. Smooth False Foxglove. These are all on the edges of their ranges but unlike Afzelia they are common.
Agalinus tenuifolia (Vahl) Raf. Slender Gerardia.
Agalinus purpurea (L.) Britt. Large Purple Gerardia. Lancaster, J. E. Hyde.
Otophylla auriculata Mx. Auricled Gerardia. Fide Bigelow. Now known only from Ottawa Co.
Buchnera americana L. Blue Hearts. Fide Bigelow. Now known only from Fulton County.
Castilleja coccinea (L.) Spreng. Painted Cup. Fide Bigelow. Now known only from Franklin and Knox counties.
Pedicularis lanceolata Mx. Lanceleaf Lousewort. In the swamp along the Logan Pike a mile south of Rockbridge, the southernmost station known in this part of the state.
Pedicularis canadensis L. Wood Lousewort.
Melampyrum lineare Lam. Cow-wheat. Abundant in the edge of the woods above the canyon of Queer Creek just east of "The Gulf." The only station known south of Portage County.

**Orobanchaceae**, Broom-rape Family.

Conopholis americana (L. f.) Wallr. Squaw-root.
Leptamium virginicum (L.) Raf. (Epiphagus) Beech-drops.

**Bignoniaceae**, Bignonia Family.

Catalpa speciosa Warder. Hardy Catalpa.

**Martyniaceae,** Unicorn-plant Family.

Martynia louisiana Mill. Unicorn Plant. Reported by Bigelow as collected at Baltimore by Dr. Hor. Whether as wild or as an escape is not stated. Now known from Richland, Ross, and Lorain counties. If it was wild its natural range is greater than is credited in the manuals, which give it as "S. Ind., Ill., and Ia. to N. Mex. Also cultivated and naturalized northw."

**Lentribulaceae,** Bladderwort Family.

Utricularia macrophylla LeC. (U. vulgaris) Greater Bladderwort. Ponds along the old canal. No specimen.

Utricularia gibba L. Humped Bladderwort. Buckeye Lake only.

**Acanthaceae,** Acanthus Family.

Ruellia strepens L. Smooth Ruellia. No specimen, observed at Clark's Crossing.

Dianthera americana L. Water-willow. Common. No specimen.

*Lamiales.*

**Boraginaceae,** Borage Family.

Cynoglossum officinale L. Hound's Tongue. No specimen.

Cynoglossum virginicum L. Wild Comfrey. Occasional.

Lappula lappula (L.) Karst. (L. echinata). European Stickseed. Spread throughout the lowland forest. No specimen.

Lappula virginiana (L.) Greene. Virginia Stickseed.

Mertensia virginica (L.) DC. Virginia cowslip. No specimen.

Myosotis arvensis (L.) Lam. Field Forget-me-not. Fide Bigelow.

Myosotis virginica (L.) B. S. P. Virginia Forget-me-not.

Lithospermum arvense L. Corn Gromwell. No specimen.

Lithospermum officinale L. Common Gromwell. Fide Bigelow. No Ohio specimens. are known.

Lithospermum canescens (Mx.) Lehm. Hoary Poccoon. Fide Bigelow. Certainly very uncommon.

Onosmodium carolinianum (L.) D. C. Shaggy False Gromwell. Fide Bigelow.

Symphytum officinale L. Common Comfrey. Fide Bigelow.

**Verbenaceae,** Vervain Family.

Verbena urticifolia L. White Vervain. No specimen.

Verbena hastata L. Blue Vervain. No specimen.

Lippia lanceolata Mx. Frog-fruit. Bigelow reports this species as seen only by Dr. Hor of Baltimore. It is common enough now.

**Lamiaceae,** Mint Family.

Teucrium canadense L. American Germander. No specimen.

Isanthus brachiatus (L.) B. S. P. False Pennyroyal.

Trichostema dichotomum L. Blue Curls.

Scutellaria lateriflora L. Mad-dog Skullcap.

Scutellaria incana Muhl. Downy Skullcap.

Scutellaria cordifolia Muhl. (S. versicolor) Heart-leaf Skullcap. No specimen, common.

Scutellaria pilosa Mx. Hairy Skullcap. Collected and determined in the field by the writer on June 21, 1911. Big Pine Creek. No specimen saved. Later it was found there are no specimens in the state herbarium.
Scutellaria parvula Mx. Small Skullcap. Fide Bigelow.
Scutellaria galericulata L. Marsh Skullcap. Fide Bigelow.
Agastache nepetoides (L.) Ktze. Giant Hyslop.
Agastache scrophulariaefolius (Willd.) Ktze.
Nepeta cataria L. Catnip. No specimen.
Glechoma hederacea L. (Nepeta) Ground Ivy. No specimen.
Prunella vulgaris L. Self Heal.
Dracocephalum virginiana L. Physostegia. False Dragon Head.
Leonurus cardiaca L. Motherwort. Abundant. No specimen.
Lamium amplexicaule L. Henbit. No specimen.
Stachys tenuifolia Willd. Smooth Hedge Nettle.
Stachys asper Mx. Rough Hedge Nettle.
Monarda clinopodia L. Basal Balm.
Monarda fistulosa L. Wild Bergamot.
Blephilia hirsuta (Pursh) Torr.
Hedeoma pulegeoides (L.) Pers. American Pennyroyal. Abundant. No specimen.
Melissa officinalis L. Lemon Balm.
Origanum vulgare L. Wild Marjoram.
Koellia flexuosa (Walt) MacM. (Pycnanthemum). Narrow-leaf Mountain-mint.
Koellia pilosa (Nutt.) Britt. (Pycnanthemum). Hairy Mountain-mint.
Koellia incana (L.) Ktze. (Pycnanthemum). Hoary Mountain-mint.
Koellia mutica (L.) Britt. (Pycnanthemum). Short-toothed Mountain-mint. Fide Bigelow.
Cunilla originoides (L.) Britt. American Ditany.
Lycopus virginicus L. Bungle-weed.
Lycopus rubellus Moench. Stalked Water-hoarhound.
Lycopus americanus Muhl. (L. lucidus var.). Cut-leaf Water-hoarhound.
Mentha spicata L. Spearmint.
Mentha piperita L. Peppermint.
Mentha canadensis L. American Wild Mint.
Collinsonia canadensis L. Stone Root.

**Phrymaceae**, Lopseed Family.

Phyrma leptostachya L. Lopseed. Often the dominant herb in the forest. No specimen.

*Plantaginales.*

**Plantaginaceae**, Plantain Family.

Plantago rugellii Dec. Broad-leaf Plantain.
Plantago major L. Broad-leaf Plantain. Fide Bigelow.
Plantago lanceolata L. Rib-grass Plantain.
Plantago cordata Lam. Water Plantain. Fide Bigelow.
Plantago aristata Mx. Large Bracted Plantain. No specimen.
Plantago virginica L. Dwarf Plantain. Common. No specimen.

Subclass, INFERAE.

*Umbellales.*

**Araliaceae,** Ginseng Family.

Aralia spinosa L. Angelica-tree. Common on Queer Creek; scarce on Big Pine Creek; absent north of that point, but undoubtedly gradually extending its range to the northward. Otherwise known as a wild plant only in Clermont Co.

Aralia racemosa L. American Spikenard.

Aralia nudicaulis L. Wild Sarsaparilla. No specimen.

Panax quinquefolium L. Ginseng. Formerly abundant, but now practically exterminated. The state herbarium has a specimen collected at Lancaster by Earl Hyde, but the writer has not been fortunate enough to see it growing.

**Amiaceae,** Carrot Family.

Eryngium aquaticum L. (E. yuccaefolium of Gr. Man., ed. 7). Rattlesnake Master. Fide Bigelow.

Sanicula canadensis L. Short-styled Snake Root.

Washingtonia claytoni (Mx.) Britt. (Osmorrhiza brevistylis). Wooly Sweet-cicely. No specimen.

Washingtonia longistylis (Torr.) Britt. (Osmorrhiza). Long-styled Sweet-cicely. No specimen.

Erigenia bulbosa (Mx.) Nutt. Harbinger of Spring. No specimen.

Conium maculatum L. Poison Hemlock. Fide Bigelow.

Zizzia aurea (L.) Koch. Early Meadow Parsnip. Fide Bigelow.

Cicuta maculata L. Water Hemlock.

Deeringa canadensis (L.) Ktze. Honewort. Fide Bigelow.

Sium cicutaefolium L. Water Parsnip. Fide Bigelow.

Foeniculum foeniculum (L.) Karst. (F. vulgare). Fennel.

Thaspium barbinode (Mx.) Nutt. Hairy-jointed Meadow-parsnip. Fide Bigelow.

Thaspium trifoliatum (L.) Britt. Fide Bigelow.

Angelica atropurpurea L. Purple-stemmed Angelica.

Angelica villosa (Walt.) B. S. P.

Oxypolis rigidus (L.) Coult & Rose. Cowbane. Fide Bigelow.

Pastinaca sativa L. Wild Parsnip. Fide Bigelow.

Heracleum lanatum Mx. Cow Parsnip. Fide Bigelow.

Daucus carrota L. Wild Carrot.

**Cornaceae,** Dogwood Family.

Cornus alternifolia Lf. Alternate-leaf Cornel.

Cornus stolonifera Mx. Red Osier Dogwood. Fide Bigelow.

Cornus femina Mill. (C. candidissima, C. paniculata). Panicled Cornel.

Cornus amomum Mill. Silky Dogwood.

Cynoxylon floridum (L.) Raf. (Cornus). Flowering Dogwood.

Nyssa sylvatica Marsh. Tupelo.

*Rubiales.*

**Rubiaceae,** Madder Family.

Housfonia coerulia L. Bluets.

Houstonia longifolia Gaertn. Long-leaf Houstonia.

Cephalanthus occidentalis L. Button-bush.
Mitchella repens L. Partridge Berry.
Galium aparine L. Common Cleavers. Fide Bigelow.
Galium pilosum Ait. Hairy Bedstraw.
Galium lanceolatum Torr. Lance-leaf Wild Licorice.
Galium circaezans Mx. Wild Licorice. Fide Bigelow.
Galium triflorum Mx. Fragrant Bedstraw.
Galium tinctorium L. Stiff Marsh Bedstraw. Fide Bigelow.
Galium concinum T. & G. Shining Bedstraw.
Galium asperellum Mx. Rough Bedstraw. Fide Bigelow.

**Caprifoliaceae,** Honeysuckle Family.

Sambucus canadensis L. Common Elderberry.
Sambucus racemosa L. (S. pubens). Red Elderberry. Common in the caves of the southern section of the area; rare or absent in the northern section.
Viburnum acerifolium L. Maple-leaf Arrow-wood.
Viburnum molle Mx. Soft-leaf Arrow-wood.
Viburnum cassinoides L. Withe-rod.
Viburnum lentago L. Sheepberry. Fide Bigelow.
Viburnum prunifolium L. Black Haw.
Triosteum perfoliatum L. Horse Gentian. No specimen.
Lonicera hirsuta Eaton. Hairy Honeysuckle. Fide Bigelow.
Lonicera tartarica L. Tartarian Honeysuckle. Escaped near Sugar Grove. No specimen.

**Valerianaceae,** Valerian Family.

Valeriana pauciflora Mx. Large-flowered Valerian. No specimen. Observed in "The Gulf."

*Campanulales.*

**Campanulaceae,** Bellflower Family.

Campanula aparinoides Pursh. Marsh Bellflower. Fide Bigelow.
Campanula americana L. Tall Bellflower.
Specularia perfoliata (L.) D. C. (Legouzia). Venus's Looking Glass.

**Lobeliaceae,** Lobelia Family.

Lobelia cardinalis L. Cardinal Flower.
Lobelia syphylitica L. Blue Lobelia.
Lobelia puberula Mx. Downy Lobelia. Abundant along the Queer Creek Road below the canyon. Seen nowhere else; its most northern station in Ohio. Otherwise known only from Gallia and Meigs counties.
Lobelia spicata Lam. Pale Spiked Lobelia.
Lobelia leptostachys A. D. C. Spiked Lobelia.
Lobelia inflata L. Indian Tobacco.
Lobelia kalmii L. Kalm's Lobelia. Fide Bigelow.

*Compositales.*

**Dipsacaceae,** Teasel Family.

Dipsacus sylvestris Mill. Wild Teasel. No specimen.

**Ambrosiaceae,** Ragweed Family.

Ambrosia trifida L. Horseweed.

Ambrosia elatior L. (A. artemesiafolia). Ragweed.

Xanthium pennsylvanicum Wallr. (X. canadense auth.). American Cockleburr.

**Helianthaceae,** Sunflower Family.

Heliopsis helianthoides (L.) B. S. P. Smooth Ox-eye.

Verbesina alba (L.) Eclipta.

Rudbeckia hirta L. Black-eyed Susan.

Rudbeckia fulgida Ait. Orange Cone-flower. Fide Bigelow.

Rudbeckia laciniata L. Tall Cone-flower. Common. No specimen.

Echinacea purpurpea (L.) Moench. (Brauneria). Purple Cone-flower. Fide Bigelow.

Helianthus microcephalus T. & G. Small Wood Sunflower.

Helianthus giganteus L. Giant Sunflower.

Helianthus hirsutus Raf. Stiff-haired Sunflower.

Helianthus tuberosus L. Jerusalem Artichoke.

Ridan alternifolia (L.) Britt. (Verbesina). Actinomeris. No specimen.

Coreopsis tripteris L. Tall Tickseed.

Bidens laevis (L.) B. S. P. Smooth Burr-Marigold. Fide Bigelow.

Bidens cernua L. Nodding Burr-Marigold. No specimen.

Bidens connata Muhl. Swamp Burr-Marigold. No specimen.

Bidens frondosa L. Black Beggar-ticks. No specimen.

Bidens bipinnata L. Spanish Needles. No specimen.

Bidens trichosperma (Mx.) Britt. Tall Tickseed.

Bidens aristosa (Mx.) Britt. Western Tickseed. On the edge of its range; reported only from counties west of the present area. No specimen.

Galinsoga parviflora hispida D. C. (G. caracsana). In Mr. Stukey's barnyard and other places. No specimen.

Polymnia canadensis L. Small-flowered Leafcup. Fide Bigelow.

Silphium perfoliatum L. Indian Cup.

Silphium trifoliatum L. Whorled Rosin Weed.

Helenium autumnale L. Common Sneezeweed. No specimen.

Inula helenium L. Elecampane.

Gnaphalium obtusifolium L. Fragrant Cudweed.

Gnaphalium uliginosum L. Marsh Cudweed.

Antennaria neglecta Greene. (det. Fernald). Field Everlasting. Upland fields.

Antennaria fallax Greene. (det. Fernald). Tall Everlasting. Woods.

Antennaria plantaginifolia (L.) Rich. (det. Fernald). Plantain-leaf Everlasting.

Antennaria parlinii Fernald (det. Fernald). Parlin's Everlasting.

Chrysopsis mariana (L.) Nutt. Maryland Golden Aster. Common in some places in the southern section of the area; known otherwise only from Jackson County.

Solidago caesia L. Wreath Goldenrod.

Solidago flexicaulis L. (S. latifolia). Zigzag Goldenrod.

Solidago bicolor L. White Goldenrod.

Solidago erecta Pursh. Slender Goldenrod. Known only from Fairfield, Hocking, and Meigs counties.

Solidago speciosa Nutt. Showy Goldenrod.

Solidago rugosa Mill. Wrinkled-leaf Goldenrod.
Solidago patula Muhl. Rough-leaf Goldenrod.
Solidago ulmnifolia Muhl. Elm-leaf Goldenrod.
Solidago neglecta T. & G. Swamp Goldenrod.
Solidago juncea Ait. Plume Goldenrod.
Solidago canadensis L. Canada Goldenrod.
Solidago nemoralis Ait. Gray Goldenrod.
Solidago rigida L. Stiff Goldenrod. Fide Bigelow.
Euthamnia graminifolia (L.) Nutt. (Solidago). Bushy Fragrant Goldenrod. Fide Bigelow.
Boltonia asteroides (L.) L'Her. Boltonia. Fide Bigelow.
Sericocarpus asteroides (L.) B. S. P. White-top Aster.
Aster divaricatus L. White Wood Aster. Common.
Aster macrophyllus L. Large-leaf Aster.
Aster shortii Hook. Short's Aster.
Aster cordifolius L. Common Blue Wood Aster. Common. No specimen.
Aster lowrieanus Port. Lowrie's Aster.
Aster sagittifolius Willd. Arrow-leaf Aster.
Aster novae-angliae L. New England Aster. No specimen.
Aster puniceus L. Purple Stemmed Aster.
Aster ericoides L. White Heath Aster.
Aster lateriflorus (L.) Britt. Starved Aster.
Erigeron puchellus Mx. Showy Fleabane.
Erigeron philadelphicus L. Philadelphia Fleabane. No specimen. Common.
Erigeron annuus (L.) Pers. White-top Fleabane.
Erigeron ramosus (Walt.) B. S. P. Daisy Fleabane. Common. No specimen.
Leptilon canadense (L.) Britt. (Erigeron). Horseweed. No specimen.
Doelingeria umbellata (Mill) Nees. (Aster). Tall White-top Aster.
D. humilis, which is reduced to a var. by Gray, is also reported by Bigelow, but is not otherwise known in Ohio.
Ionactis linearifolius (L.) Greene. (Aster). Stiff-leaf Aster. Isolated plants are not rare in the southern section of the area, but one may walk all day without seeing one even when in blossom. Otherwise known only from Adams County.
Eupatorium purpureum L. Joe-Pye-weed. Common. No specimen.
Eupatorium rotundifolium L. Round-leaf Thoroughwort. Common in the southern section, the only known Ohio station.
Eupatorium sessillifolium L. Upland Boneset.
Eupatorium perfoliatum L. Common Boneset.
Eupatorium ageratoides L. f. White Snake-root.
Eupatorium aromaticum L. Smaller White Snake-root. Common in the southern section of the area as far north as the town of Rockbridge. Reported also by Bigelow, but not otherwise known in Ohio.
Eupatorium coelastinum L. Mist-flower.
Lacinaria scariosa (L.) Hill. (Liatris). Large Blazing-star. A single specimen in the pine thicket directly west of Crystal Springs. Known elsewhere only from Erie and Lucas counties.

Lacinaria spicata (L.) Willd. (Liatris). Dense Blazing-star. Pine Barren, above Old Man's Cave, a single stalk, B. W. Wells. Also reported by Bigelow for Fairfield County.

Vernonia altissima Nutt. (V. gigantea, V. maxima). Tall Ironweed. Abundant. No specimen.

Achillea millefolium L. Common Milfoil. Abundant. No specimen.

Anthemis cotula L. Common Dog Fennel.

Chrysanthemum leucanthemum L. Ox-eye Daisy.

Tanacetum vulgare L. Common Tansy. No specimen.

Erectites hieracifolia (L.) Raf. Fireweed. Abundant. No specimen.

Mesadenia atriplicifolia (L.) Raf. (Cacalia). Pale Indian Plantain.

Senecio aureus L. Golden Groundsel. Common and conspicuous in the spring. No specimen.

Arctium minus Schk. Common Burdock. No specimen.

Cirsium lanceolatum (L.) Hill. (Carduus). Spear Thistle. No specimen.

Cirsium altissimum (L.) Spreng. Tall Thistle. No specimen.

Cirsium discolor (Muhl). Spreng. Field Thistle.

Cirsium virginianum (L.) Mx. Virginia Thistle. Fide Bigelow. Now known only from Madison County.

**Cicoriaceae,** Chicory Family.

Cynthia virginicum (L.) Ktze. (Kregia amplexicaulis, Adopogon). Virginia Dwarf-dandelion.

Leontodon taraxacum L. (T. officinale). Dandelion.

Sonchus oleraceus L. Common Sow-thistle. No specimen.

Sonchus aspera (L.) Hill. Spiny Sow-thistle. No specimen.

Lactuca virosa L. Strong-scented Lettuce.

Lactuca canadensis L. Tall Lettuce.

Lactuca spicata (Lam) Hitch. Tall Blue Lettuce. Fide Bigelow.

Lactuca integrifolia Bigel. Entire-leaf Lettuce. The only Ohio station.

Hieracium venosum L. Veined Hawkweed.

Hieracium paniculatum L. Panicled Hawkweed.

Hieracium scabrum Mx. Rough Hawkweed.

Hieracium marianum Willd. Maryland Hawkweed. I have worked over the last three in the Gray Herbarium and submitted them to Professor Fernald, but it is not possible to make very satisfactory determinations. The characters given in the manuals seem worthless for diagnosis. I give the names merely for what they are worth.

Nabalus altissimus (L.) Hook. (Prenanthes). Tall Rattlesnake-root.

Nabalus albus (L.) Hook. (Prenanthes). White Rattlesnake-root. Fide Bigelow.

Nabalus racemosus (Mx.) D. C. (Prenanthes). Glaucous Rattlesnake-root. Fide Bigelow.

Nabalus crepidineus (Mx.) D. C. (Prenanthes). Corymbed Rattlesnake-root. Fide Bigelow.

## Synopsis-Summary of the Sugar Grove Flora

| | |
|---|---|
| Phylum Ptenophyta | |
| Class, Felices | |
| Subclass, Eusporangiateae | |
| Order, Ophioglossales (p. 306) | |
| Family, Ophioglossaceae | 4 |
| Leptosporangiateae | |
| Felicales (p. 306) | |
| Osmundaceae | 3 |
| Polypodiaceae | 26 |
| Calamophyta | |
| Equiseteae | |
| Equisetales, Equisetaceae (p. 307) | 3 |
| Lepidophyta | |
| Lycopodiae | |
| Lycopodiales, Lycopodiaceae (p. 307) | 5 |
| Selaginelleae | |
| Selaginellales, Selaginellaceae (p. 307) | 1 |
| Total Pteridophytes | 42 |
| Strobilophyta | |
| Coniferae | |
| Pinales (p. 308) | |
| Pinaceae | 3 |
| Juniperaceae | 1 |
| Taxales, Taxaceae (p. 308) | 1 |
| Total Gymnosperms | 5 |
| Anthophyta | |
| Monocotyleae | |
| Helobiae (total 6) | |
| Alismales (p. 308) | |
| Alismaceae | 2 |
| Scheucherizaceae | 1 |
| Potomogetonaceae | 1 |
| Nympheales, Nympheaceae (p. 308) | 2 |
| Spadiciflorae (total 11) | |
| Pandanales (p. 308) | |
| Sparganiaceae | 2 |
| Typhaceae | 1 |
| Arales (p. 309) | |
| Araceae | 4 |
| Lemnaceae | 4 |
| Glumiflorae (total 145) | |
| Graminales (p. 309) | |
| Cyperaceae | 67 |
| Graminaceae | 78 |

| | |
|---|---|
| Liliflorae (total 59) | |
| Liliales (p. 312) | |
| Liliaceae | 21 |
| Smilacaceae | 5 |
| Pontederiaceae | 1 |
| Commelinaceae | 1 |
| Juncaceae | 5 |
| Xyridaceae | 1 |
| Iridales (p. 314) | |
| Amyrilidaceae | 1 |
| Dioscoreaceae | 1 |
| Iridaceae | 3 |
| Orchidales, Orchidaceae (p. 314) | 20 |
| Total Monocotylae | 221 |
| Dicotylae | |
| Thalamiflorae (total 118) | |
| Fanales (p. 315) | |
| Magnoliaceae | 2 |
| Annonaceae | 1 |
| Ranunculaceae | 26 |
| Parnassiaceae | 1 |
| Ceratophyllaceae | 1 |
| Berberidaceae | 3 |
| Menispermaceae | 1 |
| Lauraceae | 2 |
| Brassicales (p. 316) | |
| Papaveraceae | 2 |
| Fumariaceae | 3 |
| Brassicaceae | 22 |
| Geraniales (p. 317 | |
| Geraniaceae | 2 |
| Oxalidaceae | 4 |
| Limnanthaceae | 1 |
| Linaceae | 1 |
| Balsamiaceae | 2 |
| Rutaceae | 1 |
| Simarubaceae | 1 |
| Polygolaceae | 5 |
| Euphorbiaceae | 7 |
| Callitrichaceae | 1 |
| Malvales (p. 318) | |
| Malvaceae | 5 |
| Tiliaceae | 1 |
| Guttiferales (p. 318) | |
| Hypericaceae | 7 |
| Cistaceae | 3 |
| Violaceae | 13 |
| Passifloraceae | 1 |

Centrospermae (total 49)

Caryophyllales (p. 319)

| | |
|---|---|
| Caryophyllaceae | 16 |
| Aizoaceae | 1 |
| Portulacaceae | 2 |
| Phytolaccaceae | 1 |

Chenopodiales (p. 320)

| | |
|---|---|
| Corrigiolaceae | 1 |
| Amaranthaceae | 2 |
| Chenopodiaceae | 4 |
| Polygonales, Polygonaceae (p. 320) | 21 |
| Piperales, Saururaceae (p. 321) | 1 |

Calyciflorae (total 123)

Rosales (p. 321)

| | |
|---|---|
| Rosaceae | 43 |
| Fabaceae | 43 |

Saxifragales (p. 323)

| | |
|---|---|
| Crassulaceae | 2 |
| Saxifragaceae | 7 |

Thymelales (p. 324)

| | |
|---|---|
| Lythraceae | 2 |
| Thymelaceae | 1 |

Celastrales (p. 324)

| | |
|---|---|
| Rhamnaceae | 3 |
| Vitaceae | 4 |
| Celastraceae | 3 |
| Ilicaceae | 1 |
| Staphyleaceae | 1 |

Sapindales (p. 324)

| | |
|---|---|
| Aesculaceae | 2 |
| Aceraceae | 6 |
| Anacardiaceae | 5 |

Amentiferae (total 55)

Platanales (p. 325)

| | |
|---|---|
| Hammelidaceae | 1 |
| Platanaceae | 1 |

Urticales (p. 325)

| | |
|---|---|
| Ulmaceae | 3 |
| Moraceae | 3 |
| Urticaceae | 5 |

Fagales (p. 326)

| | |
|---|---|
| Fagaceae | 12 |
| Betulaceae | 7 |
| Juglandaceae | 7 |
| Salicales, Salicaceae (p. 326) | 16 |

Myrtiflorae (total 19)

Myrtales (p. 327)

| | |
|---|---|
| Hydrangeaceae | 1 |
| Grossulariaceae | 2 |
| Onagaraceae | 9 |
| Haloragidaceae | 1 |
| Loascales, Cucurbitaceae (p. 327) | 2 |
| Aristolochiales, Aristolochiaceae (p. 327) | 3 |
| Santalales, Santalaceae (p. 328) | 1 |

Heteromerae (total 26)

| | |
|---|---|
| Primulales, Primulaceae (p. 328) | 10 |

Ericales (p. 328)

| | |
|---|---|
| Pyrolaceae | 5 |
| Monotropaceae | 2 |
| Ericaceae | 5 |
| Vacciniaceae | 5 |
| Ebenales, Ebenaceae (p. 329) | 1 |

Tubiflorae (total 146)

Polemoniales (p. 329)

| | |
|---|---|
| Polemoniaceae | 6 |
| Convolvulaceae | 3 |
| Cuscutaceae | 2 |
| Hydrophyllaceae | 6 |

Gentianales (p. 329)

| | |
|---|---|
| Oleaceae | 3 |
| Gentianaceae | 7 |
| Apocynaceae | 2 |
| Asclepiadaceae | 10 |

Scrophulariales (p. 330)

| | |
|---|---|
| Solanaceae | 9 |
| Scrophulariaceae | 31 |
| Orobanchaceae | 2 |
| Bignoniaceae | 1 |
| Martyniaceae | 1 |
| Lentribulaceae | 2 |
| Acanthaceae | 2 |

Lamiales (p. 332)

| | |
|---|---|
| Boraginaceae | 12 |
| Verbenaceae | 3 |
| Lamiaceae | 37 |
| Phrymaceae | 1 |
| Plantaginales, Plantaginaceae (p. 333) | 6 |

Inferae (total 168)

Umbellales (p. 334)

| | |
|---|---|
| Araliaceae | 4 |
| Amiaceae | 19 |
| Cornaceae | 6 |

Rubiales (p. 334)

| | |
|---|---|
| Rubiaceae | 12 |
| Caprifoliaceae | 10 |
| Valerianaceae | 1 |

Campanulales (p. 335)

| | |
|---|---|
| Campanulaceae | 3 |
| Lobeliaceae | 5 |

Compositales (p. 335)

| | |
|---|---|
| Dipsacaceae | 1 |
| Ambrosiaceae | 3 |
| Helianthaceae | 88 |
| Cichoriaceae | 16 |
| Total Dicotylae | 704 |
| Grand total | 972 |

## Bulletins Ohio Biological Survey

I. Outline of Biological Survey Plan.
Syrphidae of Ohio by C. L. Metcalf - - - $ .50

II. Catalog of Ohio Vascular Plants
by John H. Schaffner - - - - - - - - - .50

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Region by R. F. Griggs - - - - - - - - - .50

THE OHIO STATE UNIVERSITY BULLETIN
VOLUME XIX NUMBER 5

# OHIO BIOLOGICAL SURVEY

## BULLETIN 4

## A REVIEW OF THE DESCRIBED SPECIES OF THE ORDER

# Euglenoidina Bloch

## CLASS FLAGELLATA (PROTOZOA) WITH PARTICULAR REFERENCE TO THOSE FOUND IN THE CITY WATER SUPPLIES AND IN OTHER LOCALITIES OF OHIO

BY

L. B. WALTON

MARCH, 1915

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# OHIO BIOLOGICAL SURVEY

HERBERT OSBORN, Director

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## OHIO STATE UNIVERSITY IN CO-OPERATION WITH OTHER OHIO COLLEGES AND UNIVERSITIES

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VOLUME I BULLETIN 4

# Ohio Biological Survey

## A REVIEW OF THE DESCRIBED SPECIES OF THE ORDER EUGLENOIDINA BLOCH. CLASS FLAGELLATA (PROTOZOA) WITH PARTICULAR REFERENCE TO THOSE FOUND IN THE CITY WATER SUPPLIES AND IN OTHER LOCALITIES OF OHIO

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# CONTENTS

# THE EUGLENOIDINA OF OHIO

A Review of the Described Species of the order Euglenoidina Bloch. class Flagellata (Protozoa) with particular reference to those found in the city water supplies and in other localities of Ohio.

*L. B. Walton*

## 1. Introduction.

### (a) GENERAL.

Among the minute forms of life frequenting inland waters and in particular, lakes, ponds, reservoirs, and stagnant pools, is an order of single celled organisms belonging to the class Flagellata of the Protozoa, the representatives of which possess characteristics of both animals and plants. They are not only of interest from their economic importance, inasmuch as many of the species at times occur in great numbers and impart peculiar odors, tastes, and colors to water, rendering it unpalatable for drinking purposes, but they are also of much interest from an educational standpoint, since they furnish an extremely valuable type in general use for biological instruction both in collegiate work and in the laboratory work of the better grades of high schools.

While the majority of species are sufficiently distinct from one another to permit of recognition, the absence of a satisfactory review has prevented any general knowledge of these small organisms and has also resulted in many errors and inaccuracies of classification even among those biologists who have interested themselves in the forms allied to Euglena. It was largely with a view of attempting to remedy such conditions that the present paper, the outcome of studies during the past ten years, was commenced. Just as the work was nearing completion, Pascher and Lemmermann's "Die Süsswasserflora Deutschlands, Osterreichs und der Schweiz" (Flagellatae, 1914) was issued. While the tables of genera and species, nearly all completed at that time in

Contributions from the Biological Laboratory of Kenyon College No. 12.

the manuscript of the present paper, were closely in agreement with those of the "Süsswasserflora," making due allowance for individual viewpoints, there are several distinctions in the treatment of the material which may be mentioned. The synoptic tables for the separation of species, etc., are not dichotomous as are the tables in the following pages where only two possibilities "$A^1$" and "$A^2$," etc., are presented at a time. With the assumption that the characters utilized are of equal value, dichotomous tables certainly furnish a better means toward the classification of organisms than tables where three, four or more similar characters are relatively considered at the same time. The present paper furthermore aims to note all recognized species and varieties of the order distributed throughout the world, including the few forms which are marine. The paper of Lemmermann approaches completeness in this respect, inasmuch as the group is a cosmopolitan one, in that almost any restricted area where the organisms are carefully studied will furnish representatives of nearly all known species. He omits the marine forms, however.

The Euglenoidina are of microscopic size, rarely exceeding $200\mu$[1]—usually $10\text{-}60\mu$—in length and are in general inhabitants of the fresh water, although a few are marine and a few parasitic. In common with most other minute organisms which are aquatic, they are uniformly distributed throughout the temperate and tropical regions of the world. Consequently in a review of the species found in Ohio it has seemed advisable to also include all described forms, inasmuch as a majority of these will eventually be found to occur in the state.

The work hitherto done in connection with the Euglenoidina found in Ohio is comprised in two check lists of Protozoa. The first, a "Report on the Protozoa of Lake Erie," by Jennings (U. S. Fish Com. Bull. 1889), who notes fifteen species of the order from localities near Put-in-Bay. The second, a list of "The Protozoa of Sandusky Bay and Vicinity," by Landacre (Proc. Ohio Acad. of Science, Vol. 4, Pt. 10, 1908), lists thirty species with many interesting notes. Fifty-two species from Ohio are given in the present paper, which also includes one hundred and ninety-four species which have been described from various parts of the world. No tables or figures are presented in either of the preceding lists.

1 One micron ($1\mu$) equals one thousandth of a millimeter.

### (b) METHODS.

The apparatus and supplies needed in a study such as outlined consist of a good microscope provided with an oil immersion objective and the general accessories. The instrument will cost approximately $75 and a Spencer 40 or 46 G, or a Bausch and Lomb BB-8 will be found quite satisfactory, although where cost is not a prohibitive factor the Leitz "Monobjective" binocular, costing approximately $250, duty free, with the apochromatic optical equipment is to be recommended. Magnifications should range from 50-2500. Among accessories may be mentioned slides; cover glasses (22-25m round); half dozen small pipettes; one dozen watch glasses (Syracuse pattern); a stage micrometer ruled in 1/10 and 1/100mm; an ocular micrometer; camera lucida ($10-$20); 2-H and 6-H "Kohinoor" drawing pencils; lens paper; dissecting needles, tweezers, and scissors, etc. An Irving Pitt No. 9108 Note Cover (I-P Mfg. Co., Kansas City), with paper punched to fit (procure a light weight bond at a paper supply house, size 8 x 10½, and have punched to fit cover) is useful in keeping notes and drawings together. These supplies, with the exception of the Note Cover, may be procured from the Spencer Lens Co., of Buffalo; the Bausch and Lomb Co., of Rochester, or from the U. S. branch of E. Leitz, 30 E. 18th Street, New York City.

Small drinking glasses with rectangular pieces of glass placed on top to prevent too rapid evaporation (a slight opening should be left), may be used as aquaria, while one or two quart milk pails make excellent collecting receptacles. Where smaller quantities of material are collected, and it is desirable to prevent contamination, ground glass stoppered bottles with metal screw caps (Betz Co., Hammond, Indiana), which come in pads usually containing six bottles, may be used. These are easily sterilized and may be kept as small aquaria until the culture is exhausted. Quantitative methods of study have not been utilized in the present paper.

### (c) NEW SPECIES.

Four new species of Euglenoidina are noted in the following pages. *Euglena simulacra* from Fremont, Ohio. *Euglena truncata* from Hiawatha Lake, Mt. Vernon, Ohio. *Scytomonas dobelli* from the digestive tract of *Molge vulgaris*, Europe. *Plocotia marina*, a marine form, from Woods Hole, Mass.

(d) ACKNOWLEDGMENTS.

It is appropriate to note that much of the systematic work on the Euglenoidina by the writer has been based on material obtained in connection with investigations made possible through the Emerson McMillin Fund.

## 2. Structure.

The Euglenoidina are typically elongately oval or spindle-shaped in form with a length of from 6-500 microns. They are provided with a single (rarely two) flagellum (1) arising from a cytopharynx (5) and consisting of an axial filament (2) surrounded by protoplasm (3). They possess either a rapid rotating swimming movement drawing themselves forward by means of the flagellum, or a creeping, twisting (metabolic) movement.

The protoplast (22) secretes a periplast (21) which may be thin or thick and covered with longitudinal or spiral striae (18) composed of punctuations (19). The protoplast often secretes a shell in addition to the periplast, which may be covered with spines or other formations. The stigma (6) normally present in the green Euglenidae varies from orange red to a dull yellow. There is usually present a large vacuole (9) with a vacuolar canal opening into the reservoir (7), narrowed anteriorly into a cytopharynx (5), and one or more contractile vacuoles (8) which empty into the large vacuole.

In various genera chloroleucites (17, 23) give the protoplast a green color and may be disciform, with the margin smooth or deeply notched, ribbon-like, or aggregated into star-like clusters. Paramylon (12, 20) in granules of various forms often containing a distinct pyrenoid (24) may also be present as a product of assimilation. The position of the nucleus (14, 15), particularly in the green forms, is designated by a clear space near the middle of the body and consists of a central (15) mass surrounded by chromosomes (14). Near the nucleus and only demonstrable by careful technical methods there is often a basal granule (blephroplast?) (16), from which the flagellum may arise by two filaments (10). In the family Peranemidae a pharyngeal siphon (11) or rod-like organ of uncertain function is often present.

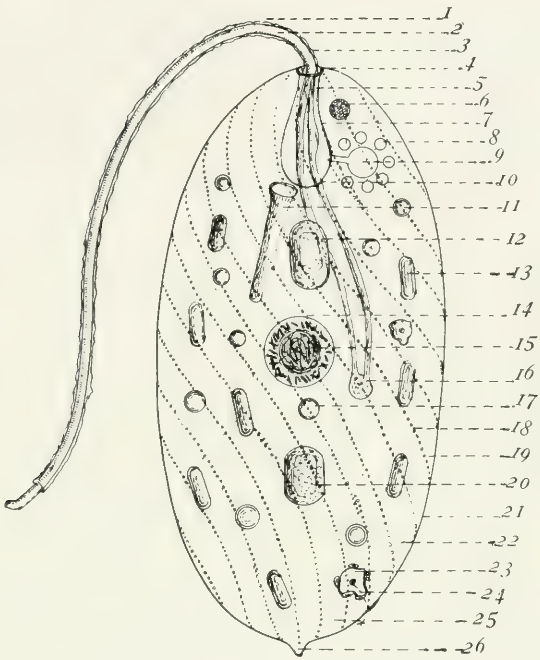


**Fig. 1, A Typical Euglenoid.**

1. flagellum.
2. axial filament.
3. flagelloplast.
4. collar.
5. cytopharynx.
6. stigma.
7. reservoir.
8. secondary vacuole.
9. primary vacuole.
10. double filament.
11. pharyngeal rod.
12. paramylon (ant. prim. gran.)
13. paramylon (secondary gran.)
14. nucleus (periph. area).
15. nucleus (cent. area).
16. basal granule.
17. chloroleucite. (regular).
18. stria.
19. punctuations.
20. paramylon (post. prim. gran.)
21. periplast.
22. protoplast.
23. chloroleucite (irregular).
24. pyrenoid.
25. interstrial area.
26. tip.

### 3. Development.

Reproduction may occur by asexual vegetative division or by sexual reproduction, although substantial evidence as to the various phases in the latter is still absent.

The vegetative reproduction consists of either a longitudinal division of the normal individual or the division of the individual after having undergone an encystment stage. In the latter case the cyst often divides a number of times, forming many small cysts more or less closely connected. The small individual escaping from the cyst may grow into a mature form or undergo the complicated process of a sexual cycle by the copulation of the individuals.

The form of the spores, particularly among the Euglena, is of considerable systematic importance.

### 4. Economic Importance.

#### (a) GENERAL RELATIONS TO WATER SUPPLIES.

The practical importance of the Euglenoidina in their relation to man is based upon several considerations. They constitute one of the principal groups of the unicellular organisms which possess chlorophyl and are able to absorb the various inorganic salts as well as the oxygen and carbon dioxide contained in the water and thus produce starch-like substances. These substances in turn through the intermediate crustacea, etc., form the basis of the food supply of the fishes and other animal organisms living in an aquatic environment. Economic phases of this nature, which pertain to the fishing industry as well as to water fowl, etc., particularly of the region of the Great Lakes, will be more appreciated as time brings about a diminishing supply of such animal organisms and threatens the commercial importance of the industries dependent thereon.

Water from both public and private supplies often has unpleasant tastes or odors and in the majority of cases the result is due to the presence of organisms of microscopic size which reach their maximum development, so far as numbers are concerned, in reservoirs, ponds, and lakes. Inasmuch as such conditions are usually due to the substances—oil globules, etc.—set free when the minute forms of life are in a state of disintegration, the filtration of the water, particularly mechanical filtration, does not necessarily remove the unpleasant taste, although the proper kind of filtration accompanied by aeration usually proves successful. When ground waters from infiltration galleries—deep wells in

proximity to streams or lakes—or chemically and mechanically purified surface waters are pumped into open reservoirs large numbers of microscopic organisms may develop. If the storage reservoirs are covered and the light necessary to the growth of forms having chlorophyl is shut out, the number of organisms is much lessened.

While the Euglenoidina, which are under consideration in the present paper, form only one of several groups of organisms that from time to time pollute water supplies, they are on many occasions responsible for disagreeable conditions of the water. The specific forms causing the trouble have been recognized with difficulty, however, owing to the absence of satisfactory tables for the separation of genera and species, and thus attempts at identification have only been partially successful, even in the hands of specialists.

Various species of the Euglenoidina give off a recognizable "violet" odor, as has been noted in the Annual Report of the State Board of Health of Massachusetts for 1892. Butschli, 1884, ascribed a "fishy" odor to *Euglena sanguinea* when the cells were found to be disintegrated and suggested that the odor was not due to putrefactive processes as had earlier been supposed, but to the oil vacuoles formed during metabolism and contained in the protoplasm of the individual.

Zacharias in 1902 called attention to the pools of water turned red by the immense numbers of *Astasia haematodes (Euglena haematodes* (Ehrenb.) ). A similar condition has often been observed in pools throughout Ohio and other states usually during the months of July and August and results from an allied form, *Euglena sanguinea,* Ehrenb. *Euglena rubra,* Hardy, produces the same result in Australia, while *Euglena orientalis,* Kashyops, is another red form which has been described from the Shalamar Gardens in Lahore, India.

When such organisms as the Euglenoidina pollute water supplies in considerable numbers, they may be eliminated by the copper sulphate method. The quantity required for the specific organisms varies from 0.4 pounds per a million gallons of water for Uroglena to 41.5 pounds per a million gallons for Beggiota.

Trout are killed by an application of 1.2 pounds, while sunfish and black bass can withstand 10-17 pounds. Euglena and probably most other forms of the order are killed by the use of 0.4 pounds to a million gallons of water.

The method employed is that of taking ordinary commercial crystals of blue vitriol to the required amount, placing in a coarse bag and drawing through the water at the stern of a row boat in parallel paths approximately twenty feet apart until the chemical is dissolved.

The various technical details in connection with the calculation of the volume of the water, the influence of the temperature of the water on the solubility of the crystals, the amount of organic material in the water as well as the specific kinds of organisms present, render it advisable to consult some one familiar with the process before undertaking purification by the copper sulphate method.

(b) NOTES ON ORGANISMS IN OHIO WATER SUPPLIES.

A considerable number of water supplies in the state were examined and samples taken from receiving and storage reservoirs. Among the cities visited were Cincinnati, Columbus, Cleveland, Akron, Dayton, Cuyahoga Falls, Canton, Hamilton, etc. While representatives of the Euglenoidina were not found in every instance, a result to be expected inasmuch as the group is a restricted one as compared with the numerous other groups of unicellular and multicellular organisms occurring in fresh water, many species of much interest were noted. Among these may be mentioned *Leptocinclis acicularis* from the Cincinnati water supply, previously known only from Hungary in Europe; *Trachelomonas teres*, known before only from New Zealand (Cincinnati water supply); *Notosolenus apocamptus* and *Entosiphon ovatum*, from the Hamilton storage reservoir; *Trachelomonas rugulosa* and an undescribed species of *Euglena* from the Storage Dam at Columbus; *Trachelomonas volvocina* from Cuyahoga Falls, etc.

While it is somewhat beyond the scope of the present paper, certain other fresh water organisms found in the reservoirs may be mentioned.

In the large storage reservoirs at Cincinnati were noted *Potamogeton spirillum* and *Potamogeton pectinatus*, comparatively

large water weeds. These were in small quantities and were gradually being dredged out after having withstood a considerable amount of a copper sulphate solution. Among the unicellular forms were *Centropyxis aculeata, Trachelomonas teres, Entosiphon sulcatum, Cosmarium, Pleurosigma, Spirillum,* etc. In the storage reservoir containing the purified water from immediately above the weir where the water was aerated, were obtained *Difflugia constricta* among filaments of *Cladophora glomerata, Trachelomonas globularis, Amoeba sp., Aspidisca costata, Navicula, Cosmarium, Oscillatoria,* etc. None occurred, however, in quantities which would impart tastes or odors to the water.

At Hamilton in an uncovered reservoir situated across the river on the hill were found *Cladophora crispata* submerged on the bottom of the reservoir; *Halteria grandinella, Pediastrum tetras, Codonosiga botrytis, Chilomonas paramecium*, species of *Planarians,* etc.

From the Storage Dam at Columbus numerous species of *Paramecium, Amoeba, Euglena, Trachelomonas, Diatoms,* etc., as well as *Aelosoma,* one of the aquatic oligochaetes.

Other interesting species were found from samples at Lisbon, Cuyahoga Falls, Akron, etc.

### 5. Classification.

#### (a) HISTORICAL.

The history of the minute forms of aquatic life is closely connected with that of the microscope and may be said to date from Leeuewenhoeck, 1675, who was succeeded by Trembley, 1744; Muller, 1786, and Ehrenberg, 1838. The latter, by aid of improved microscopes, worked out details of structure with great care, although erroneously interpreting many of them. For instance the red pigment spot—the stigma—so generally found among the Euglenidae was supposed to be actually an eye, while the nerve ganglion which was assumed must accompany it, was described in a species of Astasia. Following Ehrenberg came Dujardin, 1841, who clearly outlined the class Mastigophora (Flagellata) as animals provided with one or more flagella. Later Stein, 1850; Kent, 1880, and others who did excellent work taking

into consideration the microscopes which they employed and the extent of the systematic territory which they attempted to cover.

During the present period careful systematic studies of the Euglenoidina began with Butschli, 1883, in Bronn's, "Classen und Ordnungen des Tierreichs." Senn in 1900 reviewed the genera of the group (Euglenineae) in connection with Engler-Prant's "Die naturlichen Pflanzenfamilien," giving excellent illustrations of representatives of each genus with tables of genera. The paper by Dangeard, 1902, entitled "Recherches sur les Eugleniens," formed a most valuable contribution to the literature on the group, covering both the systematic and structural parts, omitting largely, however, the family Peranemidae. From a systematic side it could well be criticized by the lack of conciseness so essential to papers dealing with the problems of classification. Species were enumerated, although no tables for the separation of either genera or species were included, a serious oversight in a modern systematic work. A table of contents as well as an index was also lacking.

Lemmermann in 1913 presented as a part of Pascher's "Die Süsswasserflora Deutschlands, Osterreichs und der Schweiz" a review of the "Eugleninae" (Euglenoidina) with excellent figures of nearly all species described.

### (b) PRINCIPAL CHARACTERS.

Following Klebs the order is separated into three families, the *Euglenidae,* which obtain their nourishment primarily by the action of sunlight in connection with chlorophyl (holophytic), and the *Astasiidae* and *Peranemidae,* which obtain their nourishment by the absorption of organic substances through the surface of the body (saprophytic or saprozoic).

Without entering into any argument as to the relative position of the Euglenoidina among animals and plants, the termination *-idae* has been used with the family names in accordance with Zoological classification.

The principal characters utilized for the purposes of classification are the *form* of the cell—radial, bilateral, elongate, spherical, broad, fusiform, provided with a collar which may be notched

or consist of an annular thickening, etc.; structure of *periplast*—elastic or metabolic, firm, striated either spirally or more rarely longitudinally, the striae consisting of minute elevations as a rule, development of a *shell* with or without spines, punctuations, wart-like processes, etc.; *chloroleucites* (chloroplasts) absent or present in the form of ribbon-like bands, elongated cylindrical rods, disks with margins smooth or lobed, star-like masses, all of which may or may not contain *pyrenoids; paramylon* with granules of varying forms, usually elongately spherical; *pharyngeal siphon*, a rod-like organ of unknown function present in certain *Peranemidae; stalk* present in a few forms, long, short, branched or not branched; length of *flagellum* as well as the number and position where two flagella are present; *stigma* present or absent, etc. The structural position of the characters noted is indicated in Fig. 1 on a preceding page.

Many other minor characters are used, mention of which will be made in the tables for separating genera and species.

### (c) METHOD OF STUDY.

Material from standing water—small ponds, stagnant pools, ditches, etc.—particularly where organic matter is in a state of decomposition, will invariably yield many interesting species of the Euglenoidina. If such material is placed in small bottles where, however, it should not remain more than 48 hours with the stoppers inserted, and then only when an air space approximately equal to one-third the capacity of the bottle is left, and subsequently transferred to aquaria, the scum rising on the surface within the course of a few days will contain innumerable forms. Ordinary drinking glasses make excellent aquaria. They should be provided with a rectangular glass cover to prevent too rapid evaporation, although this should not entirely close the top, thereby allowing the gases arising in the decaying matter to escape.

Many species of Euglenoidina occur as "plankton" carried from place to place in large bodies of water by winds and currents and may be obtained with a plankton net made of finely meshed "bolting cloth" drawn through the water.

If one wishes to ascertain the number of organisms present in a definite body of water such as a reservoir or pond from which

water supplies are obtained, quantitative methods of study must be used. A measured amount of water—500-2000cc—is passed through an apparatus for concentrating the organisms. This may consist of a glass funnel inserted into the stoppered neck of a wide mouth bottle holding about 250cc and which also has as an overflow, a glass tube with a piece of "'bolting cloth" covering the inner end. The organisms may be reconcentrated after reaching the laboratory by passing through a funnel having some fine quartz sand in the bottom of the funnel supported by a cork with a piece of "bolting cloth" holding the sand in place. The sand must not be allowed to dry but be washed out in a watch glass in distilled water, the distillation of which has been accomplished in glass vessels with due care.

After having obtained material, rough observations made in the laboratory by placing a small quantity of water in a watch glass and examining with a magnification of 60-150 diameters, will give an idea as to the various genera and species represented. In order to properly classify the species, however, one must take a clean slide and cover glass and study with magnifications of from 500-2500 diameters, as well as ascertain the dimensions of the particular organisms with either the ocular micrometer or the camera lucida, the magnification of the microscope having first been obtained with the stage micrometer. In this connection it will be advisable to consult some of the introductory books in microscopy, such as that of Gage (Comstock Publishing Company, Ithaca, N. Y. Price $2.00) if one has not previously had experience.

The method which the writer has found best adapted for studying the Euglenoids and other microscopic organisms in the living conditions is that of utilizing a lens-paper aquarium. A piece of lens-paper is cut with the dimensions smaller than the cover glass, then by trimming out the center a ring-lie piece is left. This is placed on the middle of the slide and attached by a drop of water from a pipette. Then a drop of water containing the organisms is placed in the center, and a cover glass carefully placed over it, avoiding air bubbles by lowering gently with the tweezers. Immediately tilt the slide and draw off any surplus water with the pipette. The aquarium will keep for several hours and the cover glass will be supported by the thin layer of lens-paper and

thus not crush the organisms as the water evaporates. A permanent aquarium may be made by cutting the outside margin of the lens-paper 2-5mm smaller than the cover glass and after the water in this external area has partly evaporated (15-30 minutes) running a small quantity of paraffin oil around the margin of the cover glass. Such an aquarium will retain organisms for a month or more in a living condition provided there is a proper balance of animal and plant life.

By means of the lens-paper aquarium described the forms may be studied with the 4mm. or even the 2mm. oil immersion objective. If the movements are too rapid, they may be placed in a 2-3% solution of gelatin, which will retard their activities. Inverting a drop of water on a slide over the neck of a bottle containing a 2% solution of osmic acid will instantly kill the forms, usually without any distortion. Their life-like appearance may be lost, however, and it is always best to study first under natural conditions.

(d) CHARACTERS OF THE ORDER EUGLENOIDINA.

## Order EUGLENOIDINA Blochmann.

**Euclenoidina** Blochmann; Die mikoskopische Tierwelt d. Süsswassers, 1895; Doflein, Lehrbuch der Protozoenkunde 1911, p. 505.

**Euglenineae** Senn, Engler u. Prantl, Natürliche Pflanzenfamilien, p. 173 I Teil, Ab. $1^{a\mu}$. $1^{b}$ 1900.

**Euglenida** Delage et Herouard, Traite de Zoologie Concrete, Tome 1, p. 345.

**Eugleninae** Lemmermann, Die Süsswasserflora Deutschlands, Osterreichs und der Schweiz Heft 2, p. 115, 1914.

Form elongately oval with a pharynx from which one or more, rarely two, flagella extend; body metabolic but not amoeboid, provided with a firm periplast which is often striated or sculptured; excretory system complicated usually with a comparatively large reservoir into which one or more contractile vacuoles open; anteriorly near the base of the pharynx a stigma; protoplasm containing granules of paramylon while chromatophores may or may not be present; nucleus large with central "Binnenkörper"; reproduction agamous with a single or with multiple division, although isogamous copulation has been observed in the genus Copromonas (Scytomonas).

Habitat mostly in fresh water, a few species marine, and a few parasitic.

Length 6-500 microns.

The order may be separated into three families as follows:

(e) TABLES OF FAMILIES, GENERA AND SPECIES.

## TABLE OF FAMILIES.

A[1] Green chloroleucites and red stigma present . 1. Fam. **Euglenidae**

A[2] Green chloroleucites and red stigma absent; forms colorless.

  B[1] Form radial, usually free swimming, nourishment saprophytic . . . . . . . 2. Fam. **Astasiidae**

  B[2] Form bilateral, movement usually creeping, nourishment through solid particles taken into the pharynx . . . . . . . . 3. Fam. **Peranemidae**

## 1. Fam. EUGLENIDAE Stein

**Euglenidae** Stein

Form oval elongate radial, usually somewhat flattened, the body twisted spirally, metabolic; protoplasm containing green chloroleucites as well as paramylon granules; periplast often with spirally arranged punctuations; cytopharynx present from which arises one or rarely two flagella; red stigma present; reproduction as a rule through division during the encysted stage, the cysts often being enclosed within a gelatinous envelope.

The species are inhabitants of fresh water with the exception of Trachelomonas and Eutreptia, which are also found in salt water.

The number of described species which may be recognized is 127, distributed throughout the world.

## TABLE OF GENERA

A[1] Provided with a single flagellum.

  B[1] Free swimming, not attached by a stalk.

    C[1] Not provided with a brownish protective covering.

      D[1] Periplast elastic, forms metabolic; typically radial in structure . . 1. Gen. **Euglena**

      D[2] Periplast firm, thickened, forms not metabolic; radial or compressed in structure.

E[1] Chloroleucites disk form, more or less numerous.
F[1] Form radial not compressed; usually provided with two annular paramylon granules. 2. Gen. **Leptocinclis**
F[2] Form compressed; paramylon granules of various shapes. 3. Gen. **Phacus**
E[2] Chloroleucites in the form of two elongate lateral bands . 4. Gen. **Cryptoglena**
C[2] Provided with a brown or brownish-green protective covering which usually bears rugosities or spine like processes. . 5. Gen. **Trachelomonas**
B[2] Typically sessile (free swimming during part of reproductive cycle) and attached to minute crustacea, rotifers, filamentous algae, etc.
C[1] Not provided with a basal stalk; distinct protective envelope present . . 6. Gen. **Ascoglena**
C[2] Provided with a basal stalk; distinct protective envelope not present . . . 7. Gen. **Colacium**
A[2] Provided with two flagella; form bluntly conical with posterior end more or less pointed . . . 8. Gen. **Eutreptia**

## 1. Gen. EUGLENA Ehrenberg.

Form oblong or spindle shaped, contractile; free swimming; a single anterior flagellum; body covered by an elastic periplast often provided with minute elevations arranged spirally; on the anterior end a deep groove from the base of which arises a flagellum; an anterior stigma together with a complicated vacuole system consisting of a reservoir into which one or more small contractile vacuoles open; protoplasm containing green chromatophores (chloroleucites), together with paramylon bodies both differing greatly in form and position in the various species; nucleus large, centrally located with an interior nucleolar body.

Reproduction agamous through division occurring either in the free swimming stage, where it is usually longitudinal, or during an encysted stage, where the single cyst often divides into numerous smaller cysts. Conjugation has not been definitely demonstrated, although a sexual cycle probably occurs.

The species are found chiefly in stagnant fresh water, although a few are marine and one has been noted as parasitic in a species of Mesostoma, one of the Turbellarians, although not described.

Distribution, cosmopolitan.

## TABLE OF SPECIES.

- $A^1$ Chloroleucites (green chromatophores) present with the color rarely obscured by red hematochrome.
  - $B^1$ Chloroleucites in the form of more or less flattened rods or ribbons which may be arranged into a star shaped mass or otherwise distributed throughout the protoplasm.
    - $C^1$ Color green; species usually not exceeding 70$\mu$ in length.
      - $D^1$ Some of the chloroleucites collected into star-like masses.
        - $E^1$ Star-like masses 1-2 (rarely 3) in number.
          - $F^1$ Nucleus posterior; chloroleucites in a single median star-like mass. **1. E. viridis**
          - $F^2$ Nucleus median; chloroleucites in two or three star-like masses. . **2. E. geniculata**
        - $E^2$ Star-like masses more than three in number.
          - $F^1$ Posterior end pointed; pyrenoids without shell-like covering . **3. E. olivacea**
          - $F^2$ Posterior end rounded; pyrenoids with shell-like covering . **4. E. oblonga**
      - $D^2$ Chloroleucites not collected into star-like masses, but in the shape of elongated bands.
        - $E^1$ A single chloroleucite present.
          - $F^1$ Species extremely elongated; chloroleucite straight . . **5. E. elongata**
          - $F^2$ Species comparatively short; chloroleucite spiral . . . **6. E. minima**
        - $E^2$ Two or more chloroleucites present.
          - $F^1$ Two lateral chloroleucites . **7. E. pisciformis**
          - $F^2$ Chloroleucites in the form of numerous elongated bands.
            - $G^1$ Band like chloroleucites parallel with the longitudinal axis **8. E. terricola**
            - $G^2$ Band like chloroleucites arranged spirally . . **9. E. splendens**
    - $C^2$ Color normally red; species exceeding 70$\mu$ in length.
      - $D^1$ Periplast striated; length 120-225$\mu$.
        - $E^1$ Caudal end acute; length approximately 120$\mu$. . . . . . **10. E. sanguinea**

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1. **E. orientalis** another red species with disk-like chloroleucites is noted on a succeeding page.

E² Caudal end more or less truncate; length approximately 200μ. . . . . 11. **E. rubra**
D² Periplast smooth; length 75-100μ. . 12. **E. haematodes**
B² Chloroleucites in the form of flattened disks which are often much elongated and rarely with an irregular or extremely notched outline.
C¹ Length less than 5 times the diameter.
D¹ Prominent anterior and posterior paramylon granules not present.
E¹ Chloroleucites distinctly lobed.
F¹ Form elongately oval; length 95-100μ. . . . . . . 13. **E. velata**
F² Form spindle shaped; length 85μ. 14. **E. sociabilis**
E² Chloroleucites not distinctly lobed.
F¹ Length exceeding 55μ.
G¹ Pellicula with many small granules underneath arranged spirally. . . . . . 15. **E. granulata**
G² Pellicula without distinct granules underneath.
H¹ Color green.
I¹ Chloroleucites round or oval.
J¹ Pyrenoids present in chloroleucites; length 80-90μ. 16. **E. polymorpha**
J² Pyrenoids absent in chloroleucites; length 60-70μ. 17. **E. proxima**
I² Chloroleucites slightly constricted at middle, more or less dumb-bell shaped. 18. **E. caudata**
H² Color red or yellowish red.
I¹ Cysts spherical in form. . . 19. **E. flava**
I² Cysts flasklike in form 20 **E. orientalis**
F² Length less than 50μ.
G¹ Form short cylindrical . 21. **E. variabilis**
G² Form spindle shaped . 22. **E. gracilis**
D² Prominent anterior and posterior paramylon granules present; length of individual approximately 60μ . . . . 23. **E. torta**
C² Length more than 6 times the diameter.
D¹ Posterior part of body with an acute tip.
E¹ Periplast not covered with prominent punctuations arranged either spirally

or longitudinally.

F1 Prominent anterior and posterior paramylom granules not present.

G1 Body extremely metabolic; not normally twisted into a spiral however.

H1 Chloroleucites in the form of flattened disks, numerous; posterior part of body with short acute tip . . . 24. **E. deses**

H1 Chloroleucites in the form of elongate cup shaped disks, 2-4 in number; posterior part of body with elongated acute tip 25. **E. mutabilis**

G2 Body not metabolic, normally twisted into a spiral . 26. **E. spiroides**

F2 Prominent anterior and posterior* paramylon granules present.

G1 Anterior part of body immediately in front of stigma nearly equal to the diameter of the median part of the body.

H1 Anterior and posterior paramylon granules large, suboval or spherical.

I1 Large paramylon granules, suboval; length of individual 375-500$\mu$. . . 27. **E. oxyuris**

I2 Large paramylon granules spherical; length of individual, 75$\mu$. . . 28. **E. simulacra**

H1 Anterior and posterior paramylon granules in the form of elongated rods; length of individual, 70-80$\mu$.

I1 Body exceedingly metabolic; not prolonged posteriorly into an extended acute tip; length, 120-135$\mu$. 29. **E. intermedia**

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* Occasionally lateral in **E. limnophila.**

I² Body not metabolic; prolonged posteriorly into an extended acute tip; length, 70-80$\mu$. . . . 30. **E. tripteris**

G² Anterior part of body immediately in front of stigma approximately one-half the diameter of the median part.

H¹ Posterior end not developed into a needle-like tip . . 31. **E. acus**

H² Posterior end developed into a needle-like tip.

I¹ Chloroleucites not spirally arranged; length, 80$\mu$. . . . 32. **E. limnophila**

I² Chloroleucites spirally arranged; length 125$\mu$ 33. **E. acutissima**

E² Periplast covered with prominent punctuations, arranged either spirally or longitudinally.

F¹ Flagellum short; punctuations arranged spirally. . . . 34. **E. spirogyra**

F² Flagellum as long as body; punctuations, arranged longitudinally 35. **E. fusca**

D² Posterior part of body with a rounded or truncate tip.

E¹ Paramylon granules in the form of elongate rods; tip of body rounded; length, 250-300$\mu$. . . . 36. **E. ehrenbergii**

E² Paramylon granules not rod-like; tip truncate or emarginate; length, 175$\mu$. 37. **E. truncata**

A² Chloroleucites apparently absent and the individuals colorless; stigma yellow to orange brown. . . 38. **E. quartana**

***1. E. viridis** Ehrenb (Fig. 1, Pl. XII).

Oval or fusiform; periplast striated spirally; flagellum as long as body; stigma prominent; nucleus posterior; chloroleucites in the form of elongated rods collected into a median stellate mass; paramylon granules small, round or oval, with pyrenoids.

Reproduction by longitudinal division or by encystment in a spherical state with thickened membrane colored a yellowish brown.

* Species from Ohio.

L 50-60μ. D. 14-18μ.

(var. *olivacea* L. 72-80μ. D. 16μ.)

Distribution, cosmopolitan. Storage Dam, Columbus.

Many other species have been erroneously classified as *E. viridis* in ordinary biological instruction. The posterior position of the nucleus, together with the single stellate group of chloroleucites, should easily distinguish it from several closely allied forms. The following varieties have been noted: var. *mucosa* Lemm., surrounded by mucous in swimming stage and only slightly metabolic; var. *olivacea* Klebs, distinguished primarily by the olive green color of the chloroleucites and the tendency of these to be separated into disciform fragments, together with the larger size of the form. Dangeard has suggested that the var. *hyalina* Klebs possibly belongs to the genus Astasia, inasmuch as it is deprived of chlorophyl and possesses only a rudimentary stigma.

Hiawatha Lake, Mt. Vernon, O.; Kokosing River, Gambier, O.

*2. **E. geniculata** Dujard (Fig. 2, Pl. XII).

Cylindrical elongate with periplast striated spirally; flagellum as long as body; stigma prominent; nucleus central; chloroleucites in the form of elongate rods collected into 2 or 3 stellate masses, one mass posterior to the nucleus; paramylon with pyrenoids.

Reproduction by longitudinal division, or by encystment without thickened membrane as in *E. viridis*.

L. 70-85μ. D. 12-22μ.

Distribution, cosmopolitan. Storage Dam, Columbus.

3. **E. olivacea** Schmitz (Fig. 3, Pl. XII).

Fusiform, short posteriorly, metabolic; periplast striated spirally; flagellum as long or longer than the body; chloroleucites numerous, stellate; pyrenoids not covered with paramylon; paramylon granules short, oval.

Reproduction by longitudinal division. Encystment not known.

L. 68-89μ. D. 14-21μ.

Distribution, cosmopolitan.

4. **E. oblonga** Schmitz (Fig. 4, Pl. XII).

Oval, short with rounded ends; periplast spirally striated; flagellum longer than body; nucleus central;(?); chloroleucites numerous, stellate; pyrenoids with shell; paramylon (?).

Reproduction (?).

L. 50-70$\mu$. D. 25-35$\mu$.

Distribution (?)

5. **E. elongata** Schew. (Fig. 5, Pl. XII).

Extremely elongate, fusiform, scarcely metabolic; periplast smooth; flagellum 2/3 length of body; nucleus slightly posterior; chloroleucites elongated bands; pyrenoids absent; paramylon (?).

Reproduction (?).

L. 64$\mu$. D. 5-6$\mu$.

Distribution, New Zealand in cold springs.

6. **E. minima** Francé (Fig. 6, Pl. XII).

Small, fusiform, extremely metabolic; periplast weakly striate spirally; flagellum ½ body length; nucleus (?); chloroleucites in form of spiral bands; pyrenoids 2, with shells; paramylon small, rods.

Reproduction by longitudinal division; cysts (?).

L. 27$\mu$. D. 8-9$\mu$.

Distribution, cosmopolitan (?) in swamps.

*7. **E. pisciformis** Klebs (Fig. 7, Pl. XII).

Fusiform, rounded anteriorly, short posteriorly, slightly metabolic; periplast weakly striate spirally; flagellum as long as body; stigma with prominent granulation; nucleus posterior (?); chloroleucites 2 or 3 (?) in number arranged longitudinally and nearly as long as body; pyrenoid with double shell; paramylon (?).

Reproduction by cysts forming several cells (8?) within a single membrane.

L. 25-30$\mu$. D. 5-7$\mu$.

(var. *minor* L. 18-20$\mu$. D. 4.5-5$\mu$.)

Distribution, cosmopolitan.

The var. *minor* Hansg. has a length of 18-20$\mu$ and a diameter of 4.5-5$\mu$. *E. pisciformis* is a small species with swimming movements analogous to those of a fish, whence the name. The body becomes metabolic to a slight extent when the individual ceases swimming.

Gambier, O. Pool "Hotel Hill," var. *minor* (18$\mu$ in length).

8. **E. terricola** (Dang.) (Fig. 8, Pl. XII).

Cylindrical, elongate, tip distinct, decidedly metabolic; periplast weakly striate spirally; flagellum ½ length of body; nucleus central; chloroleucites numerous, band-like, arranged longitudinally posterior to nucleus; pyrenoids 2, enclosed in paramylon; paramylon granules small, short, cylindrical.

Reproduction.

L.(?). D.(?).

Distribution, cosmopolitan(?).

9. **E. splendens** Dang. (Fig. 9, Pl. XII).

Oval with short tip; periplast with prominent punctuations arranged spirally; flagellum longer than the body; nucleus central; chloroleucites numerous, ribbon-like, arranged spirally between striate punctuations; pyrenoids absent; paramylon round, rarely rod-like.

Reproduction by longitudinal division. Encystment with division in spherical condition.

L. 70-80$\mu$. D. 22-27$\mu$.

Distribution, France, Casette near Potiers.

Distinguished from other species by the peculiar arrangement of chloroleucites, more numerous and shorter than in *E. sanguimea* and without pyrenoids.

*10. **E. sanguinea** Ehrenb (Fig. 10, Pl. XII).

Elongately oval, red, fusiform to cylindrical, with short tip, metabolic; periplast striate spirally with indistinct punctuations; flagellum 2 times length of body; chloroleucites in the form of rods or ribbons or extremely notched disks; pyrenoid with shell; paramylon round or oval; green chlorophyl of the chloroleucites obscured by the red haematochrome which may however disappear in small aquaria with changed metabolism.

Reproduction by copulation of gametes. Encystment with division in spherical state, the gelatinous envelope thick.

L. 55-120$\mu$. D. 28-33$\mu$.

Distribution, cosmopolitan.

An interesting species which at times colors pools and small ponds an intense red on the surface. In the var. *furcata* Hübner the cell is narrowed anteriorly so that a neck-like appearance results, while a spiral furrow reaches from the cytopharynx to the middle of the body.

Ohio, Cedar Point; Sandusky, in quarry ponds.

11. **E. rubra** Hardy (Fig. Pl. XII).

Cylindrical, red, with broadly rounded anterior end and posterior end suddenly narrowed into a distinct tip which is rounded posteriorly; periplast spirally striate; flagellum approximately as long as body; chloroleucites (?); pyrenoids (?); nucleus slightly posterior; paramylon short cylindrical.

Reproduction by encystment with formation of distinct membrane.

L. 150 (?) -200$\mu$. D. 50 (?) -60$\mu$.

Distribution, cosmopolitan. Australia; Europe, Bohemia.

The species was described by Hardy, 1911, in association with *E. viridis* in small pools at Donocaster, Australia, and more recently it has been noted from Bohemia. It appears quite distinct from *E. sanguinea*.

12. **E. haematodes** (Ehrenb), (Fig. 12, Pl. XII).

Fusiform, red, metabolic; periplast smooth; flagellum 1½-2 times length of body; stigma absent (?); chloroleucites in the form of rods and ribbons (notched disks ?); pyrenoids (?); paramylon round or oval; protoplast colored red by haematochrome.

Reproduction by longitudinal division. Encystment with a thick membrane and subsequent division.

L. 75-103$\mu$. D. 28-36$\mu$.

Distribution, cosmopolitan (?).

*13. **E. velata** Klebs (Fig. 13, Pl. XII).

Elongately oval with short tip, rounded anteriorly, metabolic; periplast weakly striate spirally; flagellum as long or somewhat shorter than the body; nucleus large, median; stigma large, granu-

lar; chloroleucites 20-30 in number, distinctly lobed; pyrenoids double shelled; paramylon (?).

L. 90-100$\mu$. D. 25-30$\mu$.

Distribution, Europe and North America; Ohio, Gambier, Brook, McElroy Farm, with filaments of Lyngbya.

14. **E. sociabilis** Dang. (Fig. 1, Pl. XIII).

Fusiform with short tip, metabolic; periplast (?) flagellum longer than body; nucleus (?); chloroleucites numerous—about 10 in number; pyrenoids double shelled; paramylon oval or rod-like.

Reproduction by encystment with subsequent division resulting in spherical colonies of 2, 4, or 8 cells each with stigma and nucleus distinct.

L. 85$\mu$. D. 25$\mu$.

Distribution, France.

15. **E. granulata** (Klebs), (Fig. 2, Pl. XIII).

Fusiform with short tip, metabolic; pellicula spirally striate, yellowish brown with distinct punctuations; flagellum as long as body; nucleus central; chloroleucites in the form of large disks with slightly irregularly borders, each containing a prominent pyrenoid; paramylon (?).

Reproduction by encystment within a gelatinous envelope.

L. 60-90$\mu$. D. 20-25$\mu$.

Distribution, Europe. Cosmopolitan (?)

The var. *luteo* Lemm. is colored light green.

*16. **E. polymorpha** Dang. (Fig. 3, Pl. XIII).

Oval approaching cylindrical, metabolic with short tip; periplast striated spirally, light brown in color; flagellum twice as long as body; nucleus central (?); chloroleucites 15 or more in number in the form of disks with irregular borders, each containing a pyrenoid; paramylon oval, often absent.

Reproduction, encystment spherical with gelatinous membrane.

L. 80-90$\mu$. D. 20-25$\mu$.

First found by Dangeard near Potiers in company with *E. sanguinea.*

Mirror Lake, O. S. U., O., from stems of *Eleodea.* Length 93$\mu$.

*17. **E. proxima** Dang. (Fig. 4, Pl. XIII).

Fusiform, not elongately cylindrical with colorless tip, metabolic; periplast spirally striate; flagellum 1-1½ times length of body; nucleus central; chloroleucites numerous, disciform, about 50 in each individual; pyrenoids absent; paramylon small, elongately oval or annular (?).

Reproduction by encystment with cysts spherical, two cells being formed in a common envelope.

L. 60-70$\mu$. D. 20$\mu$.

Distribution, France, Potiers. Storage Dam, Columbus.

The elongately oval chloroleucites suggests a form somewhat intermediate between those possessing elongated rods and those with flattened disks.

18. **E. caudata** Hübner (Fig. 5, Pl. XIII).

Broadly fusiform with narrowed elongate tip, metabolic; periplast spirally striate; flagellum as long as body; nucleus central; chloroleucites numerous, dumb-bell shaped; pyrenoids with a double shell; paramylon (?).

Reproduction (?).

L. 110$\mu$. D. 38$\mu$.

Distribution, Europe (?).

19. **E. flava** Dang. (Fig. 6, Pl. XIII).

Fusiform with short tip, red, metabolic; periplast (?) ; flagellum about length of body; nucleus (?) ; chloroleucites 3-15 in number, disciform; pyrenoids with double shell; paramylon (?).

Development by longitudinal division. Encystment with spherical cysts.

L. 60$\mu$. D. 25-30$\mu$.

Distribution, France at Potiers.

20. **E. orientalis** Kashyop (Fig. 7, Pl. XIII).

Fusiform approaching cylindrical, color red; periplast (?) ; flagellum about as long as body; chloroleucites globular; pyrenoids (?) ; paramylon disiform, about 7$\mu$ in diameter.

Reproduction by flask shaped cysts from which it escapes laterally.

L. 60-120$\mu$. D. 25 (?)-40 (?) $\mu$.

Distribution, East India, Lahore.

A species apparently quite distinct by reason of flask-like cysts and development of haematochrome.

*21. **E. variabilis** Klebs (Fig. 8, Pl. XIII).

Cylindrical, short, rounded anteriorly, decidedly metabolic; periplast strongly striate spirally; flagellum 2-3 times length of body; nucleus (?); stigma large, dark red; chloroleucites disciform, without pyrenoids; paramylon one large granule anteriorly, many small granules (?).

Reproduction by division while provided with thin gelatinous envelope.

L. 30-46$\mu$. D. 9-13$\mu$.

Distribution, cosmopolitan.

Gambier, O., Hotel Hill Spring. A form which may at least be placed as a variety of the above, although not agreeing in detail with the figure from Klebs.

22. **E. gracilis** Klebs (Fig. 9, Pl. XIII).

Cylindrical to bluntly oval without pronounced tip, decidedly metabolic; periplast spirally striate; flagellum about length of body; nucleus central; chloroleucites 12-15 in number, disciform with irregular margin; with pyrenoids; paramylon absent (?).

Reproduction by division while provided with thin gelatinous membrane. Encystment with thick gelatinous membrane.

L. 37-45$\mu$. D. 6-22$\mu$.

Distribution, France, Potiers.

A small but exceedingly active species.

*23. **E. torta** Stokes (Fig. 10, Pl. XIII).

Elongately fusiform with tip twisted, not metabolic (?); flagellum as long as body; periplast smooth; chromatophores (?); pyrenoids (?); paramylon in the form of 2 long rod-like granules anterior and posterior to the nucleus.

Reproduction by division.

L. 63$\mu$. D. (?).

Distribution, United States.

This species described by Stokes is closely allied to *E. tripteris* and may prove identical with that form.

Ohio, Milford Center.

*24. **E. deses** Ehrenb. (Fig. 1, Pl. XIV).

Elongately cylindrical or band-like in form with short tip, metabolic; periplast weakly striate spirally; flagellum short; nucleus large, oval, central; stigma prominent; chloroleucites numerous, disciform; pyrenoids without shell; paramylon in the form of short or elongate rods.

Reproduction by division with or without encystment in a gelatinous covering.

L. 70-200$\mu$. D. 17-24$\mu$.

Distribution, cosmopolitan. Gambier, O.

The species is not free swimming but constantly undergoing contortions.

25. **E. mutabilis** Schmitz (Fig. 2, Pl. XIV).

Elongately cylindrical, slightly narrowed anteriorly, tip elongate, decidedly metabolic; periplast smooth; flagellum (?) ; chloroleucites 2-4 in number in the form of entire or a single half of hollow cylinders; pyrenoids 2, without shell; paramylon small, rod-like or disk-like.

Reproduction by cysts, fusiform or cask-like in appearance.

L. 80-90$\mu$. D. 7$\mu$.

A species particularly noticeable by reason of its comparative length.

26. **E. spiroides** Lemm. (Fig. 3, Pl. XIV).

Spirally twisted in the form of an elongate band with tip at a pronounced angle; periplast weakly striate longitudinally; flagellum short; nucleus central (?) ; chloroleucites numerous, disciform; pyrenoids absent; paramylon round, small.

Reproduction (?).

L. 60-170$\mu$. D. 16$\mu$.

Distribution, Europe.

*27. **E. oxyuris** Schmarda (Fig. 4, Pl. XIV).

Extremely elongate cylindrical or slightly flattened, rounded anteriorly, posteriorly with elongate tip, form usually twisted; periplast decidedly striate spirally; flagellum ½ length of body; nucleus central; chloroleucites numerous, disciform; pyrenoids absent; paramylon in the form of 2 large annular elongate rings, one anterior, the other posterior to the nucleus.

Reproduction by longitudinal division. Encystment not known.

L. 375-490$\mu$. D. 30-45$\mu$.

Distribution, cosmopolitan.

The species is a large and interesting one, extremely well adapted for biological instruction in laboratory work. After once having found a locality it may be obtained in abundance. Longitudinal division of the mature form has been observed to take place within five hours without the reconstruction of the second paramylon granule. This was from aquarium material during midwinter, but at ordinary room temperature during the day.

Ohio, Gambier; E. Swamp on S. Bass Island, Lake Erie (Jennings); Sandusky Basket Factory Cove, L. Erie (Landacre).

*28. **E. simulacra** n. sp. (Fig. 5, Pl. XIV).

Elongately cylindrical or slightly flattened, rounded anteriorly, posteriorly with long acute tip, metabolic; periplast without pronounced spiral striations; chloroleucites disciform, numerous; pyrenoids (?); paramylon in the form of two large spherical granules, one anterior and one posterior to the nucleus, which is round.

Reproduction (?).

L. 75$\mu$. D. 8-8.5$\mu$.

Distribution, Ohio, Fremont.

This interesting species is described from several specimens observed May 6, 1913, obtained in cultures procured from Fremont, O., early in the spring. It differs from *E. oxyuris* by the presence of two large spherical instead of oval paramylon granules, by the rounder nucleus and by its much smaller size. All the forms observed were nearly identical in size. Camera lucida drawings were made. No swimming movements took place, but instead a series of slow, twisting contortions.

29. **E. intermedia** (Klebs), (Fig. 6, Pl. XIV).

Elongately cylindrical with short tip, decidedly metabolic; periplast weakly striate spirally; flagellum short; chloroleucites disciform, numerous; pyrenoids absent; paramylon consists of 2-3 (?) large rod-like granules anterior and posterior to the nucleus.

Reproduction, division in gelatinous membrane.

L. 120-135$\mu$. D. 8-12.5$\mu$.

Distribution, Europe.

The var. *klebsii* Lemm. is 78-80$\mu$ long, 7-8$\mu$ in diameter and has rod-like paramylon granules much shorter.

*30. **E. tripteris** (Dujard.), (Fig. 7, Pl. XIV).

Elongately band-like in form, spirally twisted with very long and acute tip, not metabolic; when swimming three definite areas are formed by the body; periplast weakly striate longitudinally; flagellum ½ length of body; chloroleucites numerous, disciform; pyrenoids absent; paramylon in the form of 2 elongate rod-like granules, one anterior and the other posterior to the nucleus.

Reproduction by division without formation of thickened membrane.

L. 70-80$\mu$. D. 8-14$\mu$.

Distribution, cosmopolitan.

The species appears rather rare, but is easily known by its peculiar tripartate areas when swimming. It is not metabolic.

Ohio, Gambier (Academy Pond); Milford Center.

*31. **E. acus** Ehrenb. (Fig. 8, Pl. XIV).

Extremely elongate, fusiform, tip attenuate, weakly metabolic; periplast weakly striated spirally; flagellum about 1/3 length of body; nucleus central, oval; chloroleucites numerous, discoid; pyrenoids absent; paramylon elongate rods, usually 7-12 in number, scattered through protoplast.

Reproduction (?).

L. 70-200$\mu$. D. 7-12$\mu$.

Distribution, cosmopolitan.

Two varieties have been recognized, var. *minor* Hansg. 70-75$\mu$ long and 4-6$\mu$ in diameter, from peat bogs, and var. *rigida* Hübner, extremely rigid, 110$\mu$ long and 7.5$\mu$ in diameter, with paramylon arranged spirally. The species is not found commonly. Dangeard notes only isolated examples from two localities in France. The Hiawatha Lake forms are somewhat larger than the dimensions (180$\mu$) ordinarily given.

Ohio, Mt. Vernon (Hiawatha Lake); Milford Center; Sandusky (Landacre), in vegetation from basket factory cove.

32. **E. limnophila** Lemm. (Fig. 9, Pl. XIV).

Fusiform with straight or slightly bent needle-like tip, slightly metabolic; periplast scarcely striate; flagellum short;

chloroleucites numerous, discoid; pyrenoids absent; paramylon in the form of 1-2 elongate rods anterior and posterior or lateral to the nucleus.

Reproduction (?).

L. 82$\mu$. D. 10$\mu$.

Distribution, Europe.

*33. **E. acutissima** Lemm. (Fig. 10, Pl. XIV).

Elongately fusiform, rigid, with needle-like tip; periplast weakly striate spirally; flagellum short; chloroleucites numerous, discoid, arranged in spiral lines: pyrenoids absent; paramylon in the form of 2 elongate rods, one anterior, the other posterior to the nucleus.

Reproduction (?).

L. 123$\mu$. D. 7$\mu$.

Distribution, cosmopolitan.

Ohio, Fremont.

*34. **E. spirogyra** Ehrenb. (Fig. 1, Pl. XV).

Elongately cylindrical, narrowed anteriorly while posteriorly produced into an acute tip often slightly bent into a crescentic shape, slightly metabolic; periplast yellowish brown with prominent spiral punctuations, a prominent row often alternating with a less prominent row; flagellum short; chloroleucites numerous, discoid; pyrenoids absent; paramylon in the form of 2 prominent annular granules, the one anterior, the other posterior to the nucleus.

Reproduction by longitudinal division and by cysts without a gelatinous envelope.

L. 80-150$\mu$. D. 6-20$\mu$.

Distribution, cosmopolitan.

Three varieties have been recognized, var. *abrupte-acuminata* Lemm., 125$\mu$ in length and 15$\mu$ in diameter with alternate prominent and weak rows of punctuations, and the tip distinctly set off from the rest of the cell; var. *laticlavius* (Hübner), 130$\mu$ in length and 20$\mu$ in diameter with weakly but uniformly developed rows of punctuations, and var. *marchia* Lemm., 79-100$\mu$ in length and 6-12$\mu$ in diameter with equally developed rows of punctuations which are almost in contact with one another.

The forms thus far observed by the writer from Ohio are larger than any hitherto recognized, with L. 150$\mu$ and D. 20$\mu$.

Ohio, Gambier (Acad. Pond, Bishops Pool); E. Swamp, S. Bass Island, and Portage River (Jennings); Sandusky, L. Erie, basket Factory Cove (Landacre).

35. **E. fusca** (Klebs), (Fig. 2, Pl. XV).

Elongate band-like in form, gradually narrowed posteriorly with short tip, weakly metabolic; periplast dark brown to black with longitudinal rows of distinct punctuations; flagellum as long as body; chromatophores numerous, discoid; pyrenoids absent; paramylon in the form of 2 large annular granules, anterior(?) and posterior to the nucleus.

Reproduction by longitudinal(?) division and by cysts without gelatinous covering.

L. 90-225$\mu$. D. 23-27.5$\mu$.

Distribution, Europe.

This was originally described as a variety of *E. spirogyra* by Klebs but later given a specific rank by Lemmerman.

36. **E. ehrenbergii** Klebs (Fig. 3, Pl. XV).

Elongately band-like in form with rounded ends, decidedly metabolic; periplast weakly striate spirally; flagellum less than length of body; chloroleucites numerous, discoid; pyrenoids absent(?); paramylon in the form of elongate cylindrical rods which at times are somewhat flattened or even discoid.

Reproduction(?).

L. 290$\mu$. D. 26$\mu$.

Distribution, Europe.

*37. **E. truncata;** n. sp. (Fig. 4, Pl. XV).

Elongately cylindrical or band-like in form, slightly metabolic and often assuming a twisted appearance; periplast spirally striate; flagellum less than length of body; nucleus anterior, oval; posteriorly body normally emarginate or truncate; chloroleucites numerous, discoid, 2.5$\mu$ in diameter; pyrenoids apparently absent; paramylon with large granules absent, but with many small granules about 1.5$\mu$ in diameter and 2$\mu$ in length.

Reproduction(?).

L. 175$\mu$. D. 27-29$\mu$.

Distribution, Mt. Vernon (Hiawatha Lake), O.

This species has been found in almost all cultures from Hiawatha Lake, at Hiawatha Park, Mt. Vernon, during a period of three years. Large paramylon granules are absent, while the emarginate posterior end of the body is a character of interest. The body is often twisted into bipartate or tripartate areas similar to *E. tripteris*.

The species is allied to *E. ehrenbergii* Klebs to which *Amblyophis viridis* Ehrenb. (Kent, V. 1, p. 386) must be referred but differs by the characters in the "Table." *Amblyophis aegyptiaca* Schmarda (fresh water Egypt) is not sufficiently described to place it with certainty, systematically.

38. **E. quartana** Moroff (Fig. 5, Pl. XV).

Colorless, fusiform, gradually narrowed behind, decidedly metabolic; periplast distinctly differentiated, thick but smooth; flagellum 1½ times length of body; nucleus in posterior third of body; chloroleucites absent; paramylon granules usually oval, comparatively large.

Reproduction (?).

L. 50$\mu$. D. 15$\mu$.

Distribution, Germany (Munich).

The species was described by Moroff in cultures made from drainage water at Munich in which Beggiota had developed in quantities. It should be regarded as a valid species with some doubt by reason of the possible loss of the chlorophyl due to artificial conditions.

## 2. Gen. LEPTOCINCLIS Perty.

Forms radial not compressed usually with periplast striate spirally, not metabolic. Flagellum and vacuole system as in Euglena. Chloroleucites numerous, disciform in form and normally contiguous to the pellicula. Usually provided with two large lateral annulate paramylon granules. Reproduction through division in a resting stage. Nourishment holophytic or saprophytic.

Distribution, cosmopolitan.

## TABLE OF SPECIES.

| | |
|---|---|
| A[1] Pellicula striate. | |
| B[1] Posterior end suddenly constricted to form a more or less pronounced tooth. | |
| C[1] Periplast with striae spiral. | |
| D[1] Anterior end rounded. . . . | 1. **L. ovum** |
| D[2] Anterior end produced into a neck-like process. . . . . . . . | 2. **L. sphagnophila** |
| C[2] Periplast with striae not distinctly spiral. . | 3. **L. steinii** |
| B[2] Posterior end either gradually narrowed or broadly rounded. | |
| C[1] Posterior end gradually narrowed. | |
| D[1] Anterior end broadly rounded. | |
| E[1] Form oval, posterior third not decidedly narrowed. . . . | 4. **L. buetschlii** |
| E[2] Form spindle shaped, posterior third decidedly narrowed. . . . | 5. **L. teres** |
| D[2] Anterior end gradually narrowed. | |
| E[1] In the form of a short and broad spindle. . . . . . . | 6. **L. fusiformis** |
| E[2] In the form of a long and narrow spindle. . . . . . . . | 7. **L. acicularis** |
| C[2] Posterior end broadly rounded. . . . | 8. **L. texta** |
| A[2] Pellicula smooth. | |
| B[1] Anterior end not mouth-like in appearance. . | 9. **L. globosa** |
| B[2] Anterior end mouth-like in appearance. . . | 10. **L. marssonii** |

### *1. **L. ovum** (Ehrenb), (Fig. 6, Pl. XV).

Oval, posterior end with distinct spike 6-7$\mu$ in length; periplast decidedly striate spirally; flagellum twice length of body.

Reproduction (?).

L. 30-38$\mu$. D. 15-18$\mu$.

Distribution, cosmopolitan. Standing water and Plankton.

Lemmermann recognizes four varieties: var. *globula* (Perty), spherical, L. 20-27$\mu$, D. 16-21$\mu$, with flagellum 2-3 times length of body; var. *striata* (Hubner), approaching cylindrical, L. 37-38$\mu$, D. 25$\mu$, with many annular paramylon granules; var. *punctuato-striata* Lemm., L. 27-28$\mu$, D. 20-21$\mu$, oval with punctuate striae; var. *palatina* Lemm., L. 20$\mu$., D. 20-21$\mu$., with striae composed of elongate markings. The spike is usually shorter in the varieties.

Ohio, Landacre, Sandusky (Biemiller's Cove); Magnetic Springs (Baker's Creek); Coll. Osborn.

2. **L. sphagnophila** Lemm. (Fig. 7, Pl. XV).

Oval, narrowed neck-like anteriorly, tip distinct; flagellum about twice the length of the body; periplast weakly striate spirally.

Reproduction (?).

L. 33$\mu$. D. 12$\mu$.

Distribution, Europe. Sphagnum swamps and in Plankton.

3. **L. steinii** Lemm. (Fig. 8, Pl. XV).

Short fusiform with tip distinct; periplast with distinct striae which are scarcely spiral.

Reproduction (?).

L. 22-30$\mu$. D. 8-15$\mu$.

Distribution, Europe. Standing water and Plankton.

A single variety is recognized by Lemmermann, var. *suecica* Lemm., with the posterior end slightly enlarged near the tip and with L. 24.5-26$\mu$, D. 9.5-12$\mu$.

4. **L. buetschlii** Lemm. (Fig. 9, Pl. XV).

Oval with short tip; periplast distinctly striate spirally; flagellum about 2 times length of body.

Reproduction (?).

L. 34-38$\mu$.D. 21-23$\mu$.

Distribution, Europe. Standing water.

*5. **L. teres** (Schmitz), (Fig. 10, Pl. XV).

Oval to fusiform, broadest anteriorly and with short tip; periplast distinctly striate spirally; flagellum 2 times length of body.

L. 34-38$\mu$. D. 21-23$\mu$.

Distribution, Europe. Standing water.

Gambier, O.

6. **L. fusiformis** (Carter), (Fig. 1, Pl. XVI).

Short and broadly fusiform; periplast distinctly striate spirally, flagellum about as long as body.

Reproduction (?).

L. 25-36$\mu$. D. 14-23$\mu$.

Distribution, cosmopolitan. Standing water and Plankton.

*7. **L. acicularis** Francé (Fig. 2, Pl. XVI).

Elongately fusiform; periplast with not more than 12 spiral striae; flagellum somewhat exceeding length of body.

Reproduction (?).

L. 21-22$\mu$. D. 6-9$\mu$.

Distribution, Hungary (Balaton), and North America.

A small individual 12$\mu$ long having a central nucleus and a large circular spherical (?) paramylon granule, was found among filaments of Cladophora taken from the storage reservoir immediately above the weir at the Cincinnati water works, Ohio.

*8. **L. texta** (Duj.), (Fig. 3, Pl. XVI).

Broadly oval; periplast distinctly striate spirally; flagellum 2-3 times length of body; paramylon granules numerous, cylindrical, spherical or annular in form.

Reproduction (?).

L. 52-60$\mu$. D. 38$\mu$.

Distribution, Europe. Standing water and Plankton.

Gambier, O. var. 48$\mu$ in length.

9. **L. globosa** Francé (Fig. 4, Pl. XVI).

Spherical, slightly pointed anteriorly; periplast with weak rhomboidal markings; flagellum shorter than length of body.

Reproduction (?).

L. 14-21$\mu$. D. 12-18$\mu$ (?).

Distribution, Europe.

Two varieties, *cylindrica* Lemm., short cylindrical rounded at extremities, and *fusiformis* Lemm., broadly fusiform.

10. **L. marssonii** Lemm. (Fig. 5, Pl. XVI).

Fusiform, emarginate anteriorly; periplast smooth; flagellum 1-2 times length of body.

Reproduction (?).

L. 39-40$\mu$. D. 11-13$\mu$.

Distribution, Europe. Standing water and Plankton.

### 3. Gen. PHACUS Dujardin

Form compressed, free swimming with thick, firm pellicula; not metabolic; a single flagellum; vacuole system as in Euglena;

chloroleucites numerous, disciform; paramylon granules of various forms, at times absent; reproduction during encystment in gelatinous capsules which multiply rapidly.

Distribution, cosmopolitan.

### TABLE OF SPECIES.

A¹ Posterior part of body more or less uncinate.
  B¹ Periplast smooth or with longitudinal striae.
    C¹ Sides concave. . . . . . . . **1. P. anacoelus**
    C² Sides convex.
      D¹ Lateral margins much expanded. . **2. P. alata**
      D² Lateral margins not expanded.
        E¹ Form circular from a lateral view except posterior spike-like process. . **3. P. orbicularis**
        E² Form elongate.
          F¹ Dorsal area without longitudinal carina. . . . . **4. P. pleuronectes**
          F² Dorsal area with longitudinal carina. . . . . . **5. P. triqueter**
  B² Periplast with fine wart-like processes. . . **6. P. suecica**
A² Posterior part of body not uncinate, the spike-like process either being straight or absent.
  B¹ Periplast smooth or with longitudinal striae.
    C¹ Posterior tooth-like process as long as or longer than the body. . . . . . . **7. P. longicauda**
    C² Posterior tooth-like process when present, shorter than the body.
      D¹ Posterior end with tooth-like process.
        E¹ Tooth-like process approximately ⅓ length of body. . . . **8. P. caudata**
        E² Tooth-like process extremely short. **9. P. acuminata**
      D² Posterior end without tooth-like process.
        E¹ Posterior end slightly constricted. **10. P. brevicaudata**
        E² Posterior end broadly rounded. . **11. P. stokesii**
  B² Periplast with spiral striations, minute spines, or course wart-like processes.
    C¹ Periplast with spines or wart-like processes, but without spiral striations.
      D¹ Periplast covered with minute spines. . **12. P. hispidula**
      D² Periplast covered with coarse wart-like processes. . . . . . . **13. P. monilata**
    C² Periplast with spiral striations.
      D¹ Posterior end gradually narrowed to form a tooth-like process. . . . . **14. P. pyrum**
      D² Posterior end either suddenly narrowed to form tooth-like process, or process absent,

the posterior end rounded.
E[1] Posterior tooth distinct and approximately as long as body.
F[1] Transversely oval with lateral wing-like processes. . . 15. **P. nordstedtii**
F[2] Elongately oval or cylindrical without wing-like process. . 16. **P. setosa**
C[2] Posterior tooth either much shorter than the body or absent.
D[1] Posterior end acute, in some species elongated into a tooth-like process.
E[1] Posterior end with long tooth-like process ½ to ⅔ the length of the body. . . . . . . 17. **P. striata**
E[2] Posterior end without long tooth-like process.
F[1] A single large annular paramylon granule present.
G[1] Posterior end suddenly narrowed. . . . 18. **P. oscillans**
G[2] Posterior end gradually narrowed. . . . 19. **P. parvula**
F[2] Two large annual paramylon granules present.
G[1] Elongately oval, gradually narrowed posteriorly, the length approximately 3 times the diameter. . . 20. **P. clavata**
G[2] Oval, more broadly rounded posteriorly, the length approximately 2 times the diameter. . . . 21. **P. pusilla**
D[2] Posterior end rounded. . . . 22. **P. dangeardii**

1. **P. anacoelus** Stokes (Fig. 6, Pl. XVI).

Oval or spherical with margins concave and posterior spike short and uncinate; periplast (?); flagellum approximately as long as the body.

Reproduction (?).

L. 42$\mu$. D. 35$\mu$ (?).

Distribution, cosmopolitan. U. S. A., Western New York; Austria (Prague). Shallow ponds.

2. **P. alata** Klebs (Fig. 7, Pl. XVI).

Oval or spherical with lateral margins much expanded and posterior spike short and decidedly uncinate; periplast longitudi-

nally striate; flagellum longer than body; paramylon in the form of 2 large granules, one on each side.

Reproduction (?).

L. 19$\mu$. D. 18$\mu$.

Distribution, Europe.

*3. **P. orbicularis** Hübner (Fig. 8, Pl. XVI).

Spherical with short uncinate posterior spike; periplast longitudinally striate; flagellum as long as body; paramylon in the form of one large annular granule.

Reproduction (?).

L. 70$\mu$. D. 45$\mu$.

Distribution, Europe and North America in standing water.

Ohio, Hiawatha Lake, Mt. Vernon.

*4. **P. pleuronectes** (Mull.), (Fig. 9, Pl. XVI).

Broadly oval, slightly twisted with short uncinate posterior spike, and median fold reaching posteriorly to middle of cell; periplast longitudinally striate; flagellum as long as or slightly longer than the body; paramylon, 1-2 annular granules.

Reproduction (?).

L. 45-49$\mu$. D. 33-35$\mu$.

Distribution, cosmopolitan, in standing water and Plankton.

Sandusky, Basket Factory Cove (Landacre); Magnetic Springs (Baker's Creek, O.); coll. Osborn.

*5. **P. triqueter** (Ehrenb.), (Fig. 10, Pl. XVI).

Oval, decidedly concave-convex, posterior spike short and uncinate; dorsal fold prominent, reaching from anterior to posterior end; periplast longitudinally striate; flagellum as long as body; paramylon 1-2 annular granules.

Reproduction (?).

L. 49-55$\mu$. D. 33-35$\mu$.

Distribution, cosmopolitan. In standing water.

The species is common and easily identified by the longitudinal carina or fold reaching to the posterior end, although closely allied to *P. pleuronectes* and placed as a variety of that species by some investigators. It was found in East Swamp, S. Bass Island, and East Harbor, Lake Erie, by Jennings, and in Sandusky Bay by Landacre.

Gambier, Mt. Vernon, O. (Hiawatha Lake).

6. **P. suecica** Lemm. (Fig. 1, Pl. XVII).

Broadly oval with posterior spike slightly acuminate; periplast with longitudinal striae which possess fine wart-like processes; flagellum about as long as body and arising from an anterior elevation; paramylon in the form of small round or oval granules.

Reproduction (?).

L. 34$\mu$. D. 20-21$\mu$.

Distribution, Europe.

*7. **P. longicauda** (Ehrenb.), (Fig. 2, Pl. XVII).

Oval with elongate straight posterior spike; periplast longitudinally striate; flagellum less than length of body; paramylon in the form of 1 large discoid granule.

Reproduction (?).

L. 85-115$\mu$. D. 46-70$\mu$.

Distribution, cosmopolitan, in standing water and Plankton.

Variety *torta* Lemm. is decidedly twisted.

Found by Jennings in swamps on South Bass Island and East Harbor, in Lake Erie and also by Landacre in Sandusky Bay (Basket Factory Cove).

Gambier, O.

8. **P. caudata** Hübner (Fig. 3, Pl. XVII).

Oval concave-convex with posterior spike short, straight, and the dorsal fold reaching to the posterior end; periplast longitudinally striate; flagellum as long as body; paramylon in the form of one large annular granule anterior to the nucleus and one smaller granule near the posterior spike.

Reproduction (?).

L. 45$\mu$. D. 22.5$\mu$.

Distribution, Europe. Standing water.

*9. **P. acuminata** Stokes (Fig. 4, Pl. XVII).

Broadly oval or circular with short posterior spike and a pronounced dorsal fold nearly reaching the posterior end; periplast longitudinally striate; flagellum about length of body; paramylon, 2 small round granules.

Reproduction (?).

L. 25$\mu$. D. 25$\mu$.

Distribution, North America. Streams and ponds. Storage Dam, Columbus, O.

Stokes notes the habitat in connection with Myriophyllum.

10. **P. brevicaudata** (Klebs), (Fig. 5, Pl. XVII).

Oval, without spine and with dorsal fold reaching posterior end; periplast longitudinally striate; flagellum as long as body; paramylon one annular granule.

Reproduction (?).

L. 31-35$\mu$. D. 23-25$\mu$.

Distribution, Europe. In standing water.

11. **P. stokesii** Lemm. (Fig. 6, Pl. XVII).

Broadly oval to spherical with dorsal fold attaining posterior end; periplast longitudinally striate; flagellum as long as body; paramylon 1 round granule in posterior part of cell.

Reproduction (?).

L. 46$\mu$. D. 43-46$\mu$.

Distribution, North America. In pools.

12. **P. hispidula** (Eichw.), (Fig. 7, Pl. XVII).

Oval with short straight posterior spike and tubular opening for flagellum; periplast longitudinally striate, the striae covered with minute spines; flagellum as long as body; paramylon either discoid or rod-like.

Reproduction (?).

L. 30-55$\mu$. D. 18-33$\mu$.

Distribution, cosmopolitan. Standing water.

This is probably the species figured but unnamed in Conn's paper on the protozoa of Connecticut.

13. **P. monilata** Stokes (Fig. 8, Pl. XVII).

Spherical, covered with wart-like processes, posterior spike straight; flagellum as long as body, arising from a minute elevation; paramylon (?).

Reproduction (?).

L. 39$\mu$. D. 30$\mu$ (?).

North America. Ponds.

*14. **P. pyrum** (Ehrenb.), (Fig. 9, Pl. XVII).

Oval, broadest anteriorly, provided posteriorly with elongate straight spine; periplast spirally striate; flagellum as long as body;

paramylon consisting of 2 large or several small lateral discoid granules.

Reproduction, longitudinal division without encystment.

L. 30-55$\mu$. D. 13-15$\mu$.

Distribution, cosmopolitan. Standing water.

15. **P. nordstedtii** Lemm. (Fig. 10, Pl. XVII).

Transversely oval with posterior spike distinct, straight, and as long as body; periplast forming wing-like lateral extensions with distinct spiral striae; flagellum as long as body; paramylon (?).

Reproduction (?).

L. 53$\mu$. D. 29$\mu$.

Distribution, Europe and Asia Minor.

16. **P. setosa** Francé (Fig. 11, Pl. XVII).

Broadly oval, approaching cylindrical, emarginate anteriorly, the posterior spike pronounced, straight, and as long as body; periplast spirally striate; flagellum (?) ; paramylon in the form of numerous spherical or cylindrical granules.

Reproduction (?).

L. 30-31$\mu$. D. 15$\mu$ (?).

Distribution, Europe, Hungary (Balaton).

Lemmermann notes the length of this species as 30-31$\mu$, which if including the posterior spike would be an extremely small form. The magnification of the figured specimen is given as 610, and if correct makes the actual size approximately 100$\mu$ for the total length, which is evidently an error.

17. **P. striata** Francé (Fig. 12, Pl. XVII).

Oval, often broadest posteriorly with posterior spike distinct and 1/2-1/3 the length of the body; periplast spirally striate; flagellum scarcely as long as body; paramylon 1 large discoid granule.

Reproduction (?).

L. 20-24$\mu$. D. 4-9$\mu$.

Distribution, Europe, Hungary (Balaton).

*18. **P. oscillans** Klebs (Fig. 13, Pl. XVII).

Oval, broadest anteriorly, gradually narrowed posteriorly with short but distinct tooth, lateral margins turned in toward the con-

cave ventral surface; periplast spirally striate; flagellum about length of body; paramylon 1 large discoid granule.

Reproduction (?).

L. 26$\mu$. D. 10$\mu$.

Distribution, Europe. Standing water. Storage Dam, Columbus, O.

19. **P. parvula** Klebs (Fig. 14, Pl. XVII).

Oval, broadest anteriorly, posterior end acute but without pronounced tooth; periplast spirally striate; flagellum as long as body; paramylon 1 annular granule.

Reproduction by free longitudinal division as well as by division within an envelope.

L. 17-30$\mu$. D. 9-10$\mu$.

Distribution, Europe. Standing water.

20. **P. clavata** Dang. (Fig. 15, Pl. XVII).

Conical gradually narrowed posteriorly; periplast spirally striate; flagellum about 2/3 length of body; paramylon 2 annular or several rod-like granules.

Development (?).

L. 25$\mu$ (?). D. 10$\mu$ (?).

Distribution, France.

Dangeard in the description of the species fails to note the size, stating, however, that it is allied to *P. oscillans*. Consequently provisional dimensions are given.

21. **P. pusilla** Lemm. (Fig. 16, Pl. XVII).

Elongately oval, with wing-like thickening laterally, the posterior end slightly pointed; periplast spirally striate; flagellum ½ length of body; paramylon, 2 annular granules.

Reproduction (?).

L. 20$\mu$. D. 7.5$\mu$.

Distribution, Europe. Standing water.

22. **P. dangeardii** Lemm. (Fig. 17, Pl. XVII).

Elongately oval with rounded ends, often slightly narrowed posteriorly; periplast spirally striate; flagellum as long as body; paramylon, 1 annular granule.

Reproduction (?).

L. (?). D. (?).

Distribution, France.

### 4. Gen. CRYPTOGLENA Ehrenberg.

Form oval, short, scarcely acute posteriorly, compressed, free swimming, with ventral longitudinal furrow; a single flagellum; pellicula thick as in Phacus; chloroleucites in the form of two elongate bands.

Distribution, cosmopolitan.

A single species in the genus.

*1. **C. pigra** Ehrenb. (Fig. 1, Pl. XVIII).

Body oval, rigid, flattened, slightly pointed behind; a single flagellum inserted at the bottom of a slight depression equivalent to the cytopharynx of Euglena, etc.; nucleus posterior; two elongate chloroleucites situated one on each side and extending nearly the entire length of the body; stigma in contact with anterior end of one of the chromatophores; vacuole present.

Reproduction (?).

L. 11-15$\mu$. D. 6-7$\mu$.

Distribution, cosmopolitan.

Landacre notes the species from Sandusky Bay in decaying vegetation of Biemiller's Cove under the name *Chloromonas pigra* in accordance with Kent.

### 5. Gen. TRACHELOMONAS Ehrenberg.

Free swimming forms having a single flagellum and normally provided with a protective shell of a brownish color. The individuals frequenting the shells are colored green by the chloroleucites contained in the protoplasm and are provided with a stigma, paramylon granules and other structures characteristic of the family Euglenidae. Reproduction through division inside of the shell, the new individual leaving and forming a new shell.

Distribution, cosmopolitan.

The species inhabit fresh water in ditches, pools, and ponds, particularly in stagnant waters where rusty patches of "ooze" are observable.

TABLE OF SPECIES.

A[1] Surface of shell not provided with distinct spines.
- B[1] Posterior end of shell not produced into a spine-like process.
  - C[1] Form approximately spherical or slightly oval, but never decidedly longer than wide.

D1 Spherical or elongately oval.
E1 Surface smooth or finely punctuate.
F1 Surface smooth.
G1 Shell not provided with minute perforations. . 1. **T. volvocina**
G2 Shell provided with minute perforations. . . 2. **T. perforate**
F1 Shell finely punctured. . 3. **T. intermedia**
E2 Surface with wart-like processes, with folds, or with numerous minute compact rod-like protuberances.
F1 Surface with wart-like process. 4. **T. verrucosa**
F2 Surface with folds or minute rod-like protuberances.
G1 Surface covered with folds.
H1 Folds short, not reaching from anterior to posterior end.
I1 Folds minute, diagonal. . . 5. **T. rugulosa**
I2 Folds, large irregular. . 6. **T. vermiculosa**
H2 Folds elongate, reaching from anterior to posterior end. . 7. **T. stokesiana**
G2 Surface with numerous rod-like projections.
H1 Opening for flagellum without a collar. . 8. **T. spiculifera**
H2 Opening for flagellum with a collar. . 9. **T. vestita**
D2 Transversely oval. . . . 10. **T. bernardi**
C2 Form elongately ovoid or cylindrical, the length approximately 2 times the diameter.
D1 Form oval or ovoid, not cylindrical.
E1 Form that of a regular oval.
F1 Shell smooth.
G1 Opening for flagellum approximately ½ the diameter of the shell; length 25$\mu$. . . . . . 11. **T. teres**
G2 Opening for flagellum less than ⅓ the diameter of the shell; length 13-16$\mu$. . 12. **T. oblonga**
F2 Shell covered with granulations or punctuations.
G1 Collar distinct. . . 13. **T. crebea**

G² Collar absent. . . 14 T. **lemmermannii**
E² Form ovoid, being broader either anteriorly or posteriorly.
F¹ Broadest posteriorly.
G¹ Shell smooth. . . 15. **T. ovalis**
G² Shell covered with punctuations or granulations.
H¹ Covered with fine irregular punctuations. . 16. **T. similis**
H² Covered with coarse regular granulations. . 17. **T. volzii**
F² Broadest anteriorly.
G¹ Shell smooth.
H¹ Collar absent or low.
I¹ Flagellum opening with a notched collar. . . 18. **T. eurystoma**
I² Flagellum opening only slightly thickened. . . 19. **T. incerta**
H² Collar comparatively high. . . . 20. **T. africana**
G² Shell covered with fine punctuations and lines. . 21. **T. reticulata**
D² Form cylindrical.
E¹ Shell smooth. . . . . 22. **T. euchlora**
E² Shell with coarse granulations. . 23. **T. conspersa**
B² Posterior end of shell produced into a spine-like process.
C¹ Shell either with 3 annular transverse furrows or with elongated collar the height of which approximates the diameter of the shell.
D¹ With 3 annular furrows. . . . 24. **T. annulata**
D² With elongated collar. . . . 25. **T. minor**
C² Shell without transverse furrows and elongated collar.
D¹ Anterior end of shell obliquely truncate.
E² Form oval.
F¹ Elongately oval. . . . 26. **T. affinis**
F² Transversely oval. . . 27. **T. volgensis**
E¹ Form triangular or trapezoidal. . 28. **T. acuminata**
D² Anterior end transversely truncate.
E¹ Posterior spike-like process not longer than diameter of shell.
F¹ Median part of shell cylindrical. 29. **T. urceolata**
F² Median part of shell oval.
G¹ Median part longitudinally oval. . . . 30. **T. fluviatilis**

G² Median part transversely oval. . . . . 31. **T. schauinslandii**
E² Posterior spike-like process longer than diameter of shell . . 32. **T. ensifera**
A² Surface of shell provided with distinct spines.
B¹ Spines not uniformly distributed over entire surface.
C¹ Posterior spines absent. . . . 33. **T. acanthostoma**
C² Posterior spines present.
D¹ Spines in a single row on posterior or posterior and anterior end . . 34. **T. armata**
D² Spines covering entire shell except an equatorial belt . . . . 35. **T. raciborskii**
B² Spines uniformly distributed over entire surface.
C¹ Form spherical or nearly spherical.
D¹ Posterior part of shell not produced into a spike-like process.
E¹ Spines short and numerous.
F¹ Form spherical, covered with prominent short but distinct spines. . . . . 36. **T. globularis**
F² Form oval, largest anteriorly, covered thickly with fine minute spines . . . . 37. **T. westii**
E² Spines extremely long, equal in length to diameter of shell, about 10 in number . . . . . . 38. **T. americana**
D² Posterior part of shell produced into a spike like process . . . . 39. **T. aegyptiaca**
C² Form not spherical, the length approximately twice the diameter.
D¹ Posterior part of shell not produced into a spine like process.
E¹ Form regularly oval, neither the anterior nor the posterior end broadest.
F¹ Anterior end developed into a neck like process . . . 40. **T. piscatoris**
F² Anterior end broadly rounded.
G¹ Granulations between spines absent.
H¹ Spines as long as or longer than length of shell . . . 41. **T. setosa**
H² Spines short.
I¹ Spines bent . 42. **T. spinosa**
I² Spines straight.
J¹ Posterior end broadly rounded 43. **T. hispida**

J² Posterior end pointed . 44. **T. obtusa**
G² Granulations present between spines . . . 45. **T. horrida**
E² Form ovoid, the posterior or anterior end broadest.
F¹ Posterior end broadest . 46. **T. saccata**
F² Anterior end broadest.
G¹ Posterior end rounded, and only slightly narrower than anterior end; collar notched 47. **T. bulla**
G² Posterior end becoming decidedly narrowed; collar not notched . . . 48. **T. obovata**
D² Posterior end of shell produced into an acute or spike like process.
E¹ Definite posterior spike like process absent; collar not toothed . 49. **T. helvetica**
E² Definite posterior spike like process present; collar toothed . . 50. **T. caudata**

*1. **T. volvocina** Ehrenb. (Fig. 2, Pl. XVIII).

Shell spherical, smooth; flagellum opening with slightly thickened margin, rarely with low collar; flagellum 2-3 times length of body.

L. 7-21$\mu$.

Distribution, cosmopolitan. Standing water and Plankton.

Three varieties are recognized, var. *papillata* Lemm., shell spherical and flagellum opening surrounded by papilla; var. *cervicula* (Stokes), shell spherical with flagellum opening developed into an internal tube 7-8$\mu$ in length; var. *subglobosa* Lemm., with shell slightly elongate and flagellum opening developed into a short internal tube.

The water in small pools is at times colored a deep brown by the large numbers of individuals of the species.

Ohio, Lake Erie (Jennings) (Landacre), Gambier (Walton).

2. **T. perforata** Awerinz. (Fig. 3, Pl. XVIII).

Shell spherical with minute openings; flagellum opening with annular thickening or with low collar.

L. 17-20$\mu$. D. 16-19$\mu$.

Distribution, Europe. Standing water and Plankton.

3. **T. intermedia** Dang. (Fig. 4, Pl. XVIII).

Shell spherical, finely punctuate; flagellum opening with annular thickening; flagellum 2 times length of body.

L. 20$\mu$. D. 16$\mu$.

Distribution, Europe.

4. **T. verrucosa** Stokes (Fig. 5, Pl. XVIII).

Shell spherical, colorless, emarginate anteriorly, covered with wart-like processes; flagellum (?).

L. 24-24.5$\mu$.

Distribution, North America. Ponds.

*5. **T. rugulosa** Stein (Fig. 6, Pl. XVIII).

Spherical with weak spiral folds; flagellum 2-3 times length of body.

L. 15-23$\mu$.

Distribution, cosmopolitan. Standing water and Plankton; Columbus Storage Dam.

6. **T. vermiculosa** Palmer (Fig. 7, Pl. XVIII).

Spherical with short irregular folds; flagellum opening with annular thickening.

L. 23$\mu$.

Distribution, North America (Palmer). Found accompanying *Eunotia pectinalis* (Kutz.).

7. **T. stokesiana** Palmer (Fig. 8, Pl. XVIII).

Spherical with numerous longitudinal folds which often anastomose and at the extremities become spiral; flagellum opening a short conical tube in a flattened depression.

L. 18$\mu$.

Distribution, North America. Ponds Penn. Valley, Bucks County (Palmer).

8. **T. spiculifera** Palmer (Fig. 9, Pl. XVIII).

Spherical with numerous short projections; flagellum opening with thickening either annular or in the form of a polygon.

L. 25$\mu$.

Distribution, North America (Palmer). With *Eunotia pectinalis* (Kutz.).

9. **T. vestita** Palmer (Fig. 10, Pl. XVIII).

Spherical, thickly covered with radial spicules thickened on

distal end and with a flagellum collar having a height of between 1/3 and 1/2 the diameter of the shell; collar broadest at top; flagellum (?).

L. 25$\mu$.

Distribution, North America. Ponds with *Eunotia pectinalis* (Kutz.).

10. **T. bernardi** Wolosz. (Fig. 11, Pl. XVIII).

Transversely oval, truncate anteriorly; flagellum opening with annular thickening; flagellum 4 times length of body.

L. 10-15$\mu$. D. 15-18$\mu$.

Distribution, Java. Plankton (Sawa).

*11. **T. teres** Maskell (Fig. 12, Pl. XVIII).

Oval, smooth; flagellum opening extremely wide; collar low; flagellum about as long as body.

L. 35$\mu$. D. 15$\mu$ (?).

Distribution, New Zealand. A form 29$\mu$ long which must be referred to this species was obtained in water from one of the upper storage reservoirs at the Cincinnati water works.

*12. **T. oblonga** Lemm. (Fig. 13, Pl. XVIII).

Oval, smooth; flagellum opening with annular thickening which is at times developed into a low collar.

L. 13-16$\mu$. D. 11-12$\mu$.

Distribution, Europe and North America. Standing water.

Mirror Lake, O. S. U., Columbus, O.

Var. *truncata* Lemm. is truncate anteriorly, comparatively shorter than *oblonga* with dimensions L. 12-13$\mu$, D. 11$\mu$. Var. *punctuata* Lemm. is elongately oval and thickly covered with fine punctuations.

*13. **T. crebea** Kellicott (Fig. 1, Pl. XIX).

Oval, thickly covered with granulations; collar widened at mouth, normally straight, and minutely notched; flagellum (?).

L. 25$\mu$. D. (?).

Distribution, North America.

Found by Kellicott in Ohio and by Palmer in the Delaware, although it is here noted that the prevalent form has a collar curved to one side. This is the form which Lemmermann has considered as var. *dentata* by reason of the teeth on the collar.

14. **T. lemmermanaii** Wolosz. (Fig. 2, Pl. XIX).

Elongately oval, narrowed posteriorly, truncate anteriorly, finely punctuate; flagellum about 2 times length of body.

L. 26$\mu$. D. 13$\mu$.

Distribution, Java. Plankton (Sawa).

15. **T. ovalis** Daday (Fig. 3, Pl. XIX).

Oval, smooth, distinctly narrowed anteriorly where it is truncate, broadly rounded posteriorly; flagellum 4/5 length of body; flagellum opening 4$\mu$ in diameter and with fine marginal teeth.

L. 32$\mu$. D. 18$\mu$.

Distribution, East Africa.

16. **T. similis** Stokes (Fig. 4, Pl. XIX).

Oval, broadly rounded at both ends, irregularly punctuate; collar curved to one side and provided with irregular teeth.

L. 28$\mu$. L. 14$\mu$.

Distribution, North America.

17. **T. volzii** Lemm. (Fig. 5, Pl. XIX).

Oval, thickly covered with granulations, collar cylindrical, 4$\mu$ high.

L. 32$\mu$. D. 15.

Distribution, Sumatra.

18. **T. eurystoma** Stein (Fig. 6, Pl. XIX).

Oval, broadest anteriorly, rounded posteriorly, smooth; collar low truncate, with indentations; flagellum 2 times length of body.

L. 30-31.5$\mu$. D. 7.

Distribution, Europe. Standing water.

var. *acuta* Lemm. is pointed posteriorly with collar obliquely truncate.

19. **T. incerta** Lemm. (Fig. 7, Pl. XIX).

Oval, broadest anteriorly, gradually narrowed posteriorly; flagellum opening with annular thickening; flagellum 2-2½ times length of body.

L. 37.6$\mu$. D. 18$\mu$(?).

Distribution, Europe. Standing water.

var. *punctuata* Lemm. is 15.5$\mu$ in length and 7$\mu$ in diameter.

Oval, smooth, slightly broadest toward anterior end, collar comparatively high (5$\mu$) and small; flagellum(?).

with a collar 1$\mu$ in height.

20. **T. africana** Fritsch (Fig. 8, Pl. XIX).

L. 27-33$\mu$. D. 12$\mu$.

Distribution, Madagascar. Forest streams.

In material preserved (?) from Analamagotra near Perinet, Madagascar, collected by P. A. Methuen. The truncate posterior end of species together with its comparatively high and slender collar easily distinguishes it from other forms.

21. **T. reticulata** Klebs (Fig. 9, Pl. XIX).

Oval, colorless, broadest anteriorly, gradually narrowed posteriorly, thickly covered with fine punctuations and marks; stigma prominent; flagellum 2 times length of body.

L. 26$\mu$. D. 17$\mu$.

Distribution, Europe. In cultures of decaying organisms.

22. **T. euchlora** (Ehrenb.), Fig. 10, Pl. XIX).

Cylindrical, rounded at ends, smooth, collar low; flagellum? chloroleucites 6-10 each with pyrenoid;

L. 25$\mu$. D. ?

Distribution, Cosmopolitan. Standing water.

var. *cylindrica* (Ehrenb.) is smaller, L.23.5-27$\mu$. D.8-9$\mu$.

23. **T. conspersa.**

Broadly cylindrical, bottle shaped, widest toward base which forms a flat surface, anteriorly a prominent neck; brown or yellowish brown in color covered with irregular granules; flagellum 3 times length of body.

L. 25-35$\mu$. D. 10-25$\mu$.

Distribution, Austria (Prague). Stagnant pools.

24. **T. annulata** Daday (Fig. 12, Pl. XIX).

Fusiform with elongate neck and posterior spike, and with three transverse annular furrows which separate the shell into four areas; chloroleucites rod like; flagellum ?

L. 97$\mu$. D. 40$\mu$.

Distribution, Paraguay. Swamps and bogs.

25. **T. minor** Palmer (Fig. 1, Pl. XX).

Spherical, with extremely long collar and posterior spike; shell covered with scattered granules; spike often bent or twisted and with a length of about 17$\mu$, while the collar is 5$\mu$ in height. Flagellum ?

L. 30? D. ?

Distribution, North America. Found with *Eunotia pectinalis* (Kütz.).

26. **T. affinis** Lemm. (Fig. 2, Pl. XX).

Cylindrical with undulations, with an extended neck like process obliquely truncate, and with short but pronounced spike; flagellum 1½ times length of body.

L. 51$\mu$. D. 27$\mu$.

Distribution, Europe. Standing water.

Var. *planctonico* Wolosz., has a rough shell, L.45$\mu$ D.25$\mu$ while var. *levis* Lemm. has a shell which is comparatively broad, L. 60$\mu$. 68.5$\mu$., D. 26-27$\mu$.

27. **T. volgensis** Lemm. (Fig. 3, Pl. XX).

Transversely oval with prominent neck, smooth; posterior spike distinct; flagellum slightly longer than body.

L. 20-40$\mu$. D. 15-20$\mu$.

Distribution, Europe. Plankton of the Volga.

Var. *treubii* Wolosz., has a rough shell, L.20-40$\mu$, D.15-20$\mu$, with posterior spike 15-20$\mu$. in length. Var. *javanica* similar to *treubii* but 25$\mu$ in length, 18-20$\mu$ in diameter and with a posterior spike only 5$\mu$ long.

28. **T. acuminata** (Schmarda), (Fig. 4, Pl. XX).

Triangular or in the form of a trapezoid, smooth, distinctly narrowed anteriorly with prominent straight or slightly curved posterior spike; collar obliquely truncate; flagellum 2 times length of body.

L. 50-59$\mu$. D. ?

Distribution, Europe. In standing water.

Var. *verrucosa* Teodor. has a shell with L.26-34$\mu$ and a D.14-22$\mu$ which is irregularly covered with spinous warts or protuberances.

29. **T. urceolata** Stokes. (Fig. 5, Pl. XX).

Cylindrical with anterior neck like process transversely truncate and a prominent posterior spike; flagellum about length of body.

L. 45$\mu$. D. ?

Distribution, North America. Ponds.

30. **T. fluviatilis** Lemm. (Fig. 6, Pl. XX).

Oval, smooth or somewhat rough, with neck-like process transversely truncate, gradually narrowed posteriorly into a long ($5.5\mu$) spike; flagellum ?

L. $28.7\text{-}34\mu$. D. $12\text{-}12.5\mu$.

Distribution, Siam. Plankton Menam River.

Var. *curvata* Lemm. has a shell with L.$63\mu$ and D.$23\mu$, with the posterior spike ($16.5\mu$) curved.

31. **T. schauinslandii** Lemm. (Fig. 7, Pl. XX).

Transversely oval, covered with fine granulations, with anterior neck-like process; gradually narrowed posteriorly into a spike; flagellum ?

L. $27.5\mu$. D. $14\mu$.

Distribution, Siam. Plankton Menam River.

32. **T. ensifera** V. Daday (Fig. 8, Pl. XX).

Spherical or transversely oval, smooth, with anterior neck-like process and massive ($42\text{-}70\mu$) posterior spike; flagellum ?

L. $130\mu$. D. $44\mu$.

Distribution, Paraguay. Swamps and bogs.

Var. *ornata* Lemm. has the median part of the shell covered with minute elevations.

33. **T. acanthostoma** Stokes (Fig. 9, Pl. XX).

Spherical, finely punctuate; flagellum opening with two irregular rows of short spines.

L. $36.5\mu$.

Distribution, North America. Ponds.

34. **T. armata** (Ehrenb.), (Fig. 10, Pl. XX).

Broadly oval, not punctuate, with a circular row of comparatively long spines at posterior end; terminal spike absent; flagellum opening thickened or with low toothed collar; flagellum 2 times length of body.

L. $29\text{-}64\mu$. D. ?

Distribution, Cosmopolitan? Standing water and Plankton.

Var. *steinii* Lemm. Possesses an anterior wreath of short spines behind a circle of longer spines.

35. **T. raciborskii** Wolosz. (Fig. 11, Pl. XX).

Oval, surface thickly covered on both ends with heavy short spines; flagellum 3 times length of body.

L. 40$\mu$. D. 30$\mu$.

Distribution, Java. Plankton of Sawa River.

*36. **T. globularis** (Awerinz.), (Fig. 12, Pl. XX).

Spherical, covered with short scattered spines; flagellum opening without collar although an annular thickening often present; flagellum?

L. 20$\mu$.

Distribution, Russia (Bologoje). North America (Gambier, Ohio).

Specimens which must be referred to this species were found in a sample of water from a pool at the foot of Bishop's Hill, Gambier, Ohio, and also from the Cincinnati Storage Reservoir. The shell was green in color and covered with short blunt spines regularly arranged. No prominent collar was noticeable.

D. 27$\mu$.

37. **T. westii** Wolosz. (Fig. 13, Pl. XX).

Broadly oval, slightly widened anteriorly; thickly covered with extremely fine spicules; flagellum ?

L. 18$\mu$. D. 15$\mu$.

Distribution, Java. Plankton of Sawa River.

*38. **T. americana** Lemm. (Fig. 14, Pl. XX).

Spherical, with about 12 extremely long (12$\mu$) spines scattered irregularly over surface and with a cylindrical collar 7$\mu$ in height with spherical enlargement on the end; flagellum ?

L. 13$\mu$.

Distribution, North America. With *Eunotia pectinalis* (Kütz.). Mirror Lake, O. S. U., Columbus, O.

39. **T. aegyptiaca** Lemm. (Fig. 15, Pl. XX).

Spherical, thickly covered with fine spines; with prominent collar and posterior spike; flagellum ?

L. 56.4$\mu$.

Distribution, Cosmopolitan? Standing water.

**40. T. piscatoris** (Fisher), (Fig. 16, Pl. XX).

Cylindrical rounded posteriorly with prominent neck-like process anteriorly provided with small teeth and at times with spines; surface covered with spines; flagellum 1½-2 times length of body.

L. 25-40$\mu$. D. ?

Distribution, North America. Pools.

**41. T. setosa** Zykoff (Fig. 1, Pl. XXI).

Oval with numerous long thin spines, approximating the length of the shell, directed posteriorly; collar widened at mouth and provided with teeth; flagellum ?

L. 30$\mu$.

Distribution, Russia. Plankton of the Volga River.

*42. **T. spinosa** Stokes (Fig. 2, Pl. XXI).

Oval, thickly covered with short and somewhat curved spines; collar low, flagellum?

L. ?

Distribution, North America. Pools. Akron, Ohio, Water Reservoir.

*43. **T. hispida** (Perty), (Fig. 3, Pl. XXI).

Oval, yellowish brown, thickly covered with short spines; collar short, often absent; flagellum 1½-2 times length of body.

L. 20-42$\mu$. D. 15-26$\mu$.

Distribution, cosmopolitan. Standing water and Plankton.

The following varieties have been recognized:

var. *punctuata* Lemm. finely punctured and without spines.

var. *coronata* thickly covered with short spines while the opening of the flagellum is circled by larger spines.

var. *crenulatocollis* (Maskell) flagellum opening wide with collar expanded at top and provided with teeth.

var. *caudata* Lemm. thickly covered with spines and provided with distinct posterior spike.

var. *cylindrica* Klebs, cylindrical and thickly spined.

var. *subarmata* Schröder, covered with spines, those on the ends being much longer.

In form, number, size, and arrangement of spines the species varies widely.

Ohio, in E. Swamp on South Bass Island and in Portage River (Jennings) and on vegetation in Basket Factory Cove, San-

dusky (Landacre). Landacre also notes a variety "with spines on the ends and smooth in the middle" which may possibly be referred to *subarmata*.

Hamilton, O., storage reservoir.

44. **T. obtusa** Palmer (Fig. 4, Pl. XXI).

Cylindrical, broadly rounded anteriorly and conical posteriorly; thickly covered with spines; flagellum opening narrow; flagellum (?).

L. 33$\mu$. D. 16$\mu$.

Distribution, North America. Ponds and ditches.

45. **T. horrida** Palmer (Fig. 5, Pl. XXI).

Broadly oval, covered with numerous spines with nearly parallel margins and abruptly pointed at ends; minute wart-like processes between base of spines; collar low with widened mouth, the margin undulating; flagellum (?).

L. 40$\mu$. D. (?).

Distribution, North America. Ditches. Obtained in N. J. by Palmer and in Iowa by Edmundson.

46. **T. saccata** Lemm. (Fig. 6, Pl. XXI).

Oval, gradually narrowed anteriorly into a neck-like process; covered thickly with spines; flagellum (?).

L. (?). D. (?).

Distribution, Paraguay, S. A. Swamps and bogs.

47. **T. bulla** Stein (Fig. 7, Pl. XXI).

Elongately oval, covered with short spines, scarcely narrower posteriorly with distinct collar (6$\mu$ in height) provided with teeth; flagellum about length of body.

L. 50-59$\mu$. D. 20$\mu$ (?).

Distribution, cosmopolitan (?). Standing water.

Var. *regularis* Lemm. without spines, emarginate anteriorly, neck absent. L. 30$\mu$. D. 14$\mu$.

48. **T. obovata** Stokes (Fig. 8, Pl. XXI).

Oval, gradually narrowed posteriorly, thickly covered with short spines; flagellum opening with annular thickening; flagellum (?).

L. 22.6$\mu$. D. (?).

Distribution, North America. Swamps and bogs.

**49. T. helvetica** Lemm. (Fig. 9, Pl. XXI).

Oval, gradually narrowed posteriorly into a spike-like process; thickly covered with spines; collar present, truncate; flagellum (?).

L. (?). D. (?).

Distribution, Europe. Standing water.

**50. T. caudata** (Ehrenb.) (Fig. 10, Pl. XXI).

Oval, narrowed slightly posteriorly, thickly covered with spines; posterior spike present, straight or slightly curved; collar widened at mouth, provided with teeth; flagellum about as long as body.

L. 29-53$\mu$. D. 21$\mu$.

Distribution, cosmopolitan. Standing water.

Palmer notes this as a rare species occurring as a typical form at Tinicum, Pa., the local species having a length of 40$\mu$.

## 6. Gen. ASCOGLENA Stein.

Elongately oval similar to Euglena, but secreting a brownish yellow protective covering which gives it a flask-like form, the posterior end being attached to algae or other aquatic plants or debris in the water. General structure as in Euglena.

### TABLE OF SPECIES.

| | |
|---|---|
| A[1] Protective envelope elongately cylindrical and slightly broadened near the base . . . . . | 1. A. vaginicola |
| A[2] Protective envelope urn shaped, with distinct neck, broadest near anterior end . . . . . . | 2. A. amphoroides |

**1. A. vaginicola** Stein. (Fig. 11, Pl. XXI).

Body bluntly oval without a pronounced acute tip; stigma not prominent; chloroleucites 12-15 in number, discoid (?); paramylon granules absent (?); secreting a gelatinous protective envelope which is colored yellow or light brown through the action of iron oxide; individual fixed to bottom of protective envelope which is in turn attached to plant debris, algae, etc.

L. 43$\mu$. D. 8-16$\mu$.

Distribution, cosmopolitan (?).

**2. A. amphoroides** (Francé) (Fig. 12, Pl. XXI).

Protective envelope urn-shaped, yellowish brown, with dis-

tinct neck; interior cell oval, nearly or quite filling protective envelope; chloroleucites large, discoid, without pyrenoids; flagellum (?).

L. 18$\mu$. D. 14$\mu$.

Distribution, Hungary (Balaton). Found on Tribonema.

### 7. Gen. COLACIUM Stein.

Species attached by a pedicle to Cyclops and other small crustacea as a rule during later stages, free swimming during early stages of development. Form oval or cylindrical, several individuals usually being united into a colony attached by a single stalk; structure similar to Euglena, the flagellum becoming lost as the forms become sedentary.

Distribution, cosmopolitan.

TABLE OF SPECIES.

A[1] Body oval.
- B[1] Basal stalk shorter than length of individual. 1. **C. vesiculosum Eh.**
- B[2] Basal stalk much longer than length of individual. . . . . . . . 2. **C. arbuscula**

A[2] Body cylindrical . . . . . . . 3. **C. calvum**

*1. **C. vesiculosum** Ehrenberg (Fig. 13, Pl. XXI).

Form oval with basal stalk shorter than length of individual; length about two and one-half times the diameter when extended tapering toward each extremity but more attenuate posteriorly, pyriform and widest anteriorly when contracted; motile individuals resembling Euglena; chloroleucites oval, numerous; colonies consist of from two to eight individuals.

L. 19-29$\mu$. D. 9-17$\mu$.

Distribution, cosmopolitan. Found on Cyclops, Copepods, Rotifers, etc.

Variety *natans* Lemm. forms free swimming colonies of 4 transversely arranged cells.

A colony consisting of two representatives was found in a culture March 26, 1912, obtained about two weeks earlier from Mirror Lake on the campus of the State University at Columbus. These were attached to the second right swimming appendage of Cyclops sp. (Nauplius stage). A camera lucida drawing was made and while they were being studied a predatory *Coleps hirtus* happened along devouring both individuals.

Jennings (1900) notes the species from Cyclops in towings taken $2\frac{1}{2}$ miles north of Kelly Island, also on *Polyarthra platyptera* and various crustacea in swamps on S. Bass Island. *C. steinii* Kent, which Jennings found on *Diaptomus sp.* from surface towings in Lake Erie, must be referred to this species.

2. **C. arbuscula** Stein (Fig. 14, Pl. XXI).

Oval with basal stalk much longer than the length of the individual and much branched distally, otherwise as in *C. vesiculosum.*

L. 20-30$\mu$. D. 10-17$\mu$.

Distribution, cosmopolitan.

*3. **C. calvum** Stein (Fig. 15, Pl. XXI).

Cylindrical, with a cup-like base longitudinally striate, and with a short thick stalk; flagellum as long as body.

L. 42-48$\mu$. D. 19-20$\mu$.

Distribution, cosmopolitan. Plankton and on Crustacea.

Common at Sandusky on algae and duckweed roots from Biemillers Cove (Landacre).

## 8. Gen. EUTREPTIA Perty.

Form bluntly conical, free-swimming, provided with two flagella; posterior end somewhat attenuated when swimming; strongly metabolic with small knot-like swellings appearing anteriorly and moving posteriorly; periplast striated; chloroleucites discoid and without a pyrenoid; stigma present; nucleus central or slightly anterior; metabolic movements accompanying swimming movements as a rule.

Found in both fresh and salt water.

### TABLE OF SPECIES.

| | |
|---|---|
| $A^1$ Posterior end of body extended into a tail like appendage . | 1. E. viridis |
| $A^2$ Posterior end of body only slightly narrowed. . . | 2. E. lanowii |

1. **E. viridis** Perty (Fig. 16, Pl. XXI).

Broadly fusiform, emarginate anteriorly, with tail-like appendage posteriorly; each flagellum as long as body; paramylon in the form of round or flattened cylindrical rods.

Reproduction in resting condition within gelatinous membrane. Cysts not known except in the var. *schizochlora* Entz.

L. 49-66$\mu$. D. 3-13$\mu$.

Distribution, cosmopolitan. Standing water and Plankton.

A variety *schizochlora* has been described by Entz from ponds containing saline waters in Hungary. The paramylon is absent or in the form of small granules; reproduction by cysts with a thick membrane.

2. **E. lanowii** Steuer (Fig. 1, Pl. XXII).

Fusiform, more elongate than in preceding species, truncate anteriorly, gradually narrowed posteriorly; paramylon spherical or kidney formed.

Reproduction by division during motile condition and also by cysts with definite membrane.

L. 25-60$\mu$. D. 3-13$\mu$.

Distribution, Austria, Trieste (Grand Canal).

## 2. Fam. ASTASIIDAE Butschli.

Free-swimming, radial, non-colonial, colorless forms obtaining their nourishment as saprophytes; green chloroleucites and red stigma absent as a rule; paramylon present; often extremely metabolic.

The majority of the forms are inhabitants of fresh water, a few, however, being found in salt water.

### TABLE OF GENERA

A[1] Provided with a single flagellum.
- B[1] Body strongly metabolic . . . . . 1. Gen. **Astasia**
- B[2] Body rigid . . . . . . . . . . 2. Gen. **Menoidium**

A[2] Provided with a long and a short flagellum.
- B[1] Body strongly metabolic . . . . . 3. Gen. **Distigma**
- B[2] Body rigid . . . . . . . . . . 4. Gen. **Sphenomonas**

## 1. Gen. ASTASIA Dujardin.

Decidedly metabolic; periplast usually striate; a single flagellum; stigma rarely present; reproduction by division during free-swimming stage.

### TABLE OF SPECIES.

A[1] Forms not endoparasitic in Cyclops, Catenula, etc.
- B[1] Broadly rounded posteriorly and much narrower anteriorly . . . . . . . . 1. **A. lagenula**
- B[2] Not broadest posteriorly.
  - C[1] Oval, flattened . . . . . . . . 2. **A. inflata**

C[2] Not flattened.
D[1] Stigma present . . . . . . 3. **A. ocellata**
D[2] Stigma absent.
E[1] Cell straight.
F[1] Nucules central . . . 4. **A. klebsii**
F[2] Nucleus posterior . . . 5. **A. dangeardii**
E[2] Cell lunate . . . . . . 6. **A. curvata**
A[2] Forms endoparasitic in Cyclops, Catenula, etc.
B[1] Living in Catenula . . . . . . . . 7. **A. captiva**
B[2] Living in Cyclops . . . . . . . . 8. **A. mobilis**

1. **A. lagenula** (Schew.) (Fig. 2, Pl. XXII).

Elongate, posterior end extremely broad and rounded, giving a club-like appearance; periplast smooth; flagellum as long as body; nucleus central; paramylon granules spherical.

L. 25-30$\mu$. D. 10$\mu$.

Distribution, Malay Archipelago (Island Bali). Ditches.

2. **A. inflata** Duj. (Fig. 3, Pl. XXII).

Flattened, short, oval; periplast strongly striate spirally; flagellum as long as body; nucleus central; paramylon granules rod-like.

L. 35-46$\mu$. D. 12$\mu$.

Distribution, cosmopolitan(?). Stagnant water.

*3. **A. ocellata** Khawk. (Fig. 4, Pl. XXII).

Fusiform or somewhat cylindrical, broadest anteriorly; periplast smooth; flagellum 1½-2 times length of body; stigma present; nucleus central; paramylon granules spherical or polyhedral.

Reproduction by cysts with thick membrane.

L. 35-65$\mu$. D. 8-35$\mu$.

Distribution, cosmopolitan. Standing water.

Ohio, Mt. Vernon (Hiawatha Lake).

*4. **A. klebsii** Lemm. (Fig. 5, Pl. XXII).

Fusiform with posterior tail-like process; periplast indistinctly spirally striate; flagellum as long as body; stigma absent; nucleus central; paramylon granules oval.

L. 50-59$\mu$. D. 13-20$\mu$.

Distribution, Europe and North America. Stagnant water.

Gambier, O., Academy Pond.

5. **A. dangeardii** Lemm. (Fig. 6, Pl. XXII).

Oval or fusiform, broadest anteriorly; periplast distinctly striate spirally; flagellum as long as body; stigma absent; nucleus posterior; paramylon granules oval.

Reproduction by oval cysts with thin membrane.

L. 30-58$\mu$. D. 12-20$\mu$.

Distribution, cosmopolitan. Stagnant water.

6. **A. curvata** Klebs (Fig. 7, Pl. XXII).

Elongately cresentic, narrow, usually twisted or somewhat flattened with ends attenuated, truncate anteriorly; periplast weakly striate spirally; flagellum about 2/3 length of body; stigma absent; paramylon extremely small, elongate.

Reproduction (?).

L. 40-46$\mu$. D. 5-6$\mu$.

Distribution, cosmopolitan. Stagnant water, cultures of algae, etc.

7. **A. captiva** Beauch. (Fig. 8, Pl. XXII).

Elongately fusiform with rounded posterior end; periplast spirally striate; flagellum as long as body or absent; stigma rudimentary; nucleus central; paramylon granules round or in the form of elongate rods.

L. 30-40$\mu$. D. (?).

Distribution, France. Endoparasitic in *Catenula lemnae*.

8. **A. mobilis** (Rehberg) (Fig. 9, Pl. XXII).

Fusiform with pointed posterior end; periplast finely striate spirally; stigma present (?); nucleus anterior or posterior; paramylon round or rod-like; flagellum 1½ times length of body or absent.

L. 26-32$\mu$.

Distribution, Europe. Endoparasitic in Cyclops and in the eggs of the egg sack.

Rehberg described a form as *Lagenella mobilis* with a length of 102-103$\mu$ which was often of a green color. Alexieff has also noted a species which may be identical with *A. mobilis*.

### 2. Gen. MENOIDIUM Perty.

Body not metabolic, usually somewhat curved in longitudinal axis; nucleus central or slightly posterior to central area; pellicula

striated longitudinally; paramylon cylindrical or rectangular, numerous granules being present; movement free-swimming, rotating on axis. Four species in fresh water from 16-120$\mu$ in length.

TABLE OF SPECIES.

A[1] Form attenuate, length more than 7 times the diameter.
- B[1] Form typically lunate; flagellum as long as body; length approximately 120$\mu$ . . . . . 1. **M. falcatum**
- B[2] Form typically sigmoid; flagellum ½ as long as body; length of body 40-80$\mu$ . . . . . . 2. **M. tortuosum**

A[2] Form not attenuate, length less than 6 times the diameter.
- B[1] Narrowed into a neck like anterior end . . 3. **M. pellucidum**
- B[2] Broadly rounded anteriorly . . . . 4. **M. incurvum**

1. **M. falcatum** Zach. (Fig. 10, Pl. XI).

Comparatively narrow and decidedly curved into a form similar to a new moon, the posterior end pointed; periplast(?); flagellum as long as body; nucleus(?); paramylon granules elongate.

L. 120$\mu$. D. 14$\mu$.

Distribution, Europe. Ditches.

2. **M. tortuosum** (Stokes) (Fig. 11, Pl. XXII).

Typically in the form of a letter "S," gradually narrowed and pointed posteriorly; periplast(?); flagellum ½ length of body; nucleus central; paramylon granules elongate.

L. 42-78$\mu$. D. 5-13$\mu$.

Distribution, North America. Among decayed vegetation.

The species was originally placed in the genus Atractonema by Stokes who noted its soft flexible body which, however, was persistent in shape.

3. **M. pellucidum** Perty (Fig. 12, Pl. XXII).

Slightly curved, narrowed posteriorly with extremity rounded, anteriorly developed into a neck-like process; periplast covered with many weak striae; flagellum slightly more than ½ length of body; nucleus posterior; paramylon cylindrical, more or less elongated.

L. 39-40$\mu$. D. 7-10$\mu$.

Distribution, Europe. Stagnant water.

4. **M. incurvum** (Fres.) (Fig. 13, Pl. XXII).

Broadly cylindrical, slightly curved, broadly rounded on the ends; periplast with comparatively distant striations; flagellum

about as long as body; nucleus posterior or central; paramylon(?).

L. 16-25$\mu$. D. 7-8$\mu$.

Distribution, Europe. Stagnant water.

### 3. Gen. DISTIGMA Ehrenberg.

Decidedly metabolic, elongately fusiform; periplast weakly striate longitudinally; movement free-swimming or creeping; reproduction by division of motile forms, cysts being unknown.

A single species.

**1. D. proteus** Ehrenb. (Fig. 14, Pl. XXII).

Elongately fusiform; primary flagellum ½ length of body; secondary flagellum short; paramylon granules cylindrical.

L. 46-110$\mu$. D.(?).

Distribution, cosmopolitan(?).

### 4. Gen. SPHENOMONAS Stein.

Rigid, with longitudinal keels; periplast longitudinally striate, with a primary and secondary flagellum; reproduction by division during motile condition.

TABLE OF SPECIES.

| | |
|---|---|
| A[1] 1 longitudinal carina present . . . . . | 1. **S. teres** |
| A[2] 4 longitudinal carinae present . . . . . | 2. **S. quadrangularis** |

**1. S. teres** (Stein) (Fig. 15, Pl. XXII).

Broadly fusiform; longitudinal carina weakly developed; primary flagellum as long as or slightly longer than the length of the body; secondary flagellum short; nucleus anterior.

L. 20-40$\mu$. D. 8$\mu$.

Distribution, cosmopolitan(?). Stagnant water.

**2. S. quadrangularis** Stein (Fig. 6, Pl. XXII).

Broadly fusiform, quadrate in cross-section, with 4 well developed carinae; primary flagellum 2 times length of body; secondary flagellum short; nucleus central.

L. 30$\mu$. D.(?).

Distribution, Europe. Stagnant water.

## 3. Fam. PERANEMIDAE Ehrenberg.

Colorless, green chromatophores and red stigma being absent; form bilateral as a rule, movement usually creeping although a

swimming rotating movement occurs in a few species *(Heteronema acus* Ehrenberg, *Euglenopsis vorax* Klebs.); pharynx distinct; nourishment by means of solid particles taken into pharynx; paramylom present.

Inhabitants of fresh water, with representatives of a few genera (Urceolus, Anisonema, Ploeotia, Entosiphon) also found in salt water.

The members of this family are easily overlooked when studying the Protozoa by reason of the small size of many of the species as well as their transparent bodies. Furthermore the majority of the forms are not of frequent occurrence.

### TABLE OF GENERA.

| | |
|---|---|
| $A^1$ Flagellum directed posteriorly absent; a single anterior flagellum present. | |
| $B^1$ Rod-like organ absent. | |
| $C^1$ (Subfam. *Euglenopseae*) Free-swimming with a rotating movement; weakly metabolic; striate spirally . . . | 1. Gen. **Euglenopsis** |
| $C^2$ (Subfam. *Petalomonadeae*) Creeping; not metabolic; not striate spirally. | |
| $D^1$ Anterior end pointed; contractile vacuole marginal . . . . | 2. Gen. **Petalomonas** |
| $D^2$ Anterior end truncate; contractile vacuole anterior . . . . | 3. Gen. **Scytomonas** |
| $B^2$ (Subfam. *Peranemeae*) Rod-like organ present. | |
| $C^1$ Form spindle shaped . . . . | 4. Gen. **Peranema** |
| $C^2$ Form flask shaped . . . . | 5. Gen. **Urceolus** |
| $A^2$ Flagellum directed posteriorly present; an anteriorly directed flagellum also usually present. | |
| $B^1$ Granules not arranged spirally in the ectoplasm; species not exceeding $60\mu$. in length. | |
| $C^1$ Two flagella arising from same area present, one directed anteriorly, the other posteriorly. | |
| $D^1$ (Subfam. *Heteronemeae*) Posterior flagellum shorter than the anterior flagellum. | |
| $E^1$ Body not flattened; weakly metabolic . . . . . . | 6. Gen. **Heteronema** |
| $E^2$ Body flattened; not metabolic. | |
| $F^1$ With 6-8 longitudinal ribs. | 7. Gen. **Tropidoscyphus** |
| $F^2$ Without longitudinal ribs. | 8. Gen. **Notosolenus** |
| $D^2$ (Subfam. *Anisonemeae*) Posterior flagellum usually longer or at least equal in length to the anterior flagellum. | |

E[1] Pharyngeal siphon absent.
F[1] Posterior flagellum twice the length of the anterior flagellum.
G[1] Keel like ribs absent . 9. Gen. **Anisonema**
G[2] Keel like ribs present. 10. Gen. **Ploeotia**
F[2] Posterior flagellum approximately equal in length to the anterior flagellum.
G[1] Without an apparent ventral longitudinal furrow; metabolic . 11. Gen. **Metanema**
G[2] Without an apparent longitudinal furrow; not metabolic . . 12. Gen. **Marsupiogaster**
E[2] Pharyngeal siphon present . 13. Gen. **Entosiphon**
C[2] (Subfam. *Clautriavieae*) A single flagellum directed posteriorly . . . 14. Gen. **Clautriavia**
B[2] (Subfam. *Dinemeae*) Granules arranged spirally in the ectoplasm; species 75-80$\mu$. in length. 15. Gen. **Dinema**

## 1. Gen. EUGLENOPSIS Klebs.

Form spindle shaped, colorless or yellowish white, slightly metabolic, free swimming with rotation on axis; a single flagellum; pellicula more or less spirally striate; an anterior mouth-like fold present.

Habitat, fresh water.

Distribution, cosmopolitan (?).

The genus consists of a single species.

1. **E. vorax** Klebs (Fig. 1, Pl. XXIII).

Possessing the characters of the genus with protoplasm colorless and containing numerous paramylon granules.

L. 20-25$\mu$. D. 8$\mu$.

Distribution, cosmopolitan.

While its small size will aid in distinguishing it from many other species belonging to the family Astasiidae, some of which it resembles, the possession of the mouth-like fold is the character of importance. Thus far it has not been noted from Ohio.

## 2. Gen. PETALOMONAS Stein.

Cells rigid, not metabolic; unsymmetrical in form and often with peculiarly developed processes; periplast thick and firm and

occasionally developing a longitudinal carina or a longitudinal furrow; 1 flagellum arising from a depression on the right of the cytopharynx; a primary and a secondary vacuole usually to right of cytopharynx; nucleus usually at left of cell.

Reproduction by longitudinal division; cysts not known.

Nourishment, saprobiotic.

### TABLE OF SPECIES.

| | |
|---|---|
| A¹ Longitudinal carinae absent although longitudinal furrows which may be mistaken for carinae may be present. | |
| B¹ Posterior end without peculiarly developed processes. | |
| C¹ Lateral margins not turned inward. | |
| D¹ Broadly oval . . . . | 1. **P. mediocanellata** |
| D² Elongately oval . . . . | 2. **P. angusta** |
| C² Lateral margins turned inward . . | 3. **P. inflexa** |
| B² Posterior end with peculiarly developed processes. | |
| C¹ Posterior lateral processes 2 in number; cell not gradually narrowed anteriorly—but nearly cylindrical . . . . | 4. **P. sinuata** |
| C² Posterior processes 6 in number; cell gradually narrowed anteriorly . . . | 5. **P. sexlobata** |
| A² Longitudinal carinae present. | |
| B¹ 1-3 longitudinal carinae. | |
| C¹ 1 longitudinal carina. | |
| D¹ Carina with a sharp edge . . | 6. **P. steinii** |
| D² Carina rounded . . . . | 7. **P. carinata** |
| C² 2-3 longitudinal carinae. | |
| D¹ Posterior end rounded or truncate . | 8. **P. abscissa** |
| D² Posterior end deeply emarginate . | 9. **P. mira** |
| B² 4-5 longitudinal carinae. | |
| C¹ Carinae not extremely developed. | |
| D¹ Fusiform, rounded posteriorly; L.12-15$\mu$. | 10. **P. quadrilineata** |
| D² Oval, truncate posteriorly; L.34$\mu$. . | 11. **P. sulcata** |
| C² Carinae extremely developed, their height exceeding ordinary diameter of body . | 12. **P. alata** |

**1. P. mediocanellata** Stein (Fig. 2, Pl. XXIII).

Broadly oval, ventral and dorsal sides with furrows, that on the dorsal side being narrow; flagellum as long as body.

L. 22-25$\mu$. D. (?).

Distribution, cosmopolitan. Pools containing much vegetation.

Var. *distomata* (Stokes) has the two furrows equally broad and the anterior end of the cell slightly elongated. Found on the surface of decaying leaves in the bottom of shallow pools.

Var. *pleurosigma* (Stokes) is fusiform, similar to *P. mediocanellata,* with the posterior end pointed, and has a length of 17$\mu$. Standing pond water with aquatic vegetation.

2. **P. angusta** (Klebs) (Fig. 3, Pl. XXIII).

Elongately oval, dorsal side convex, ventral side with furrow; flagellum as long as body.

L. 14-23$\mu$. D. 7-14$\mu$.

Distribution, Europe. Pools containing much vegetation.

Var. *pusilla* (Klebs) is 7$\mu$ in length and 3-4$\mu$ in diameter; var. *lata* (Klebs) is broadly oval with short pointed posterior end, L. 22$\mu$, D. 12-14$\mu$.

*3. **P. inflexa** Klebs (Fig. 4, Pl. XXIII).

Elongately oval, flattened, broadly truncate or emarginate posteriorly, pointed anteriorly; lateral margins curled inwardly; flagellum as long as body.

L. 30$\mu$. D.(?).

Distribution, Europe and North America. Pools containing much vegetation.

var. *obliqua* Klebs has only the left lateral margin curled ventrally, while the flagellum is oblique to the longitudinal axis of the body during the swimming movement.

Var. *pellucida* Klebs is thin, transparent, and the dorsal side possesses a shallow furrow, the lateral margins curled inwardly. L. 8$\mu$, D. 8$\mu$.

Gambier, O. Small forms 11.5$\mu$ in length referable to the var. *pellucida* were obtained in a small brook filled with *Lyngbya* on the McElroy Farm.

*4. **P. sinuata** (Stein) (Fig. 5, Pl. XXIII).

Short cylindrical, pointed anteriorly and with a lateral posterior process on each margin; flagellum 1½-2 times length of body.

L. 38$\mu$. D.(?).

Distribution, Europe. Pools with much vegetation.

5. **P. sexlobata** Klebs (Fig. 6, Pl. XXIII).

Broadly oval, pointed bluntly anteriorly, with six short but

thick posterior processes turned inwardly; flagellum 2 times length of body.

L. 27-30$\mu$. D. 21-23$\mu$.

Distribution, Europe. Pools with much vegetation.

6. **P. steinii** Klebs (Fig. 7, Pl. XXIII).

Oval, trianglar in cross section; carina prominent; flagellum as long or longer than the body.

L. 38-42$\mu$. D. 22$\mu$.

Distribution, Europe. Pools with much vegetation.

7. **P. carinata** Francé (Fig. 8, Pl. XXIII).

Elongately oval, with ends rounded; carina broad, formed by membraneous fold rolled toward the right; vacuole and nucleus on median line.

L. 23$\mu$. D. (?).

Distribution, Hungary (Balaton).

8. **P. abscissa** (Duj.) (Fig. 9, Pl. XXIII).

Broadly oval or round, slightly narrowed anteriorly and often truncate posteriorly; ventral surface flat or with furrow; dorsal surface with 2 longitudinal carinae; flagellum longer than body.

L. 27.5$\mu$. D. (?).

Distribution, Europe. Pools rich in aquatic vegetation.

Var. *convergens* Klebs, is pointed anteriorly and emarginate posteriorly with the longitudinal carinae converging anteriorly and the L. 19$\mu$, the D. 17$\mu$.

Var. *parallela* Klebs is rounded anteriorly and emarginate posteriorly with the longitudinal carinae parallel although often unequal in size, L. 30$\mu$, D. 17$\mu$.

Var. *deformis* Klebs is pointed anteriorly, truncate posteriorly, with 3 longitudinal parallel carinae.

9. **P. mira** Awerinz. (Fig. 10, Pl. XXIII).

Oval with anterior end narrowed and curved toward the right, the posterior end deeply emarginate; 3 longitudinal carinae; lateral margins with a row of granules; flagellum 2 times length of body.

L. 26-30$\mu$. D. 18$\mu$.

Distribution, Russia (Bologoje-Sea). In slime.

10. **P. quadrilineata** Penard (Fig. 11, Pl. XXIII).

Fusiform, rounded posteriorly; flagellum 2 times length of body.

L. 12-15$\mu$. D.(?).

Europe, Wiesbaden.

11. **P. sulcata** Stokes (Fig. 12, Pl. XXIII).

Oval, less than twice as long as wide, truncate posteriorly, dorsal and ventral surfaces each with 4-5 longitudinal or slightly oblique carinae, which at times meet posteriorly; flagellum equal to length of body.

L. 34$\mu$. D.(?).

Distribution, North America. Ponds.

12. **P. alata** Stokes (Fig. 13, Pl. XXIII).

Oval, broadly rounded posteriorly, with 4 extremely high longitudinal carinae, height much greater than diameter of body, in furrows between carinae; flagellum 2 times length of body.

L. 23$\mu$. D.(?).

Distribution, North America. Ponds with *Ceratophyllum*.

### 3. Gen. SCYTOMONAS Stein.

Form oval, somewhat flattened; truncate anteriorly; not metabolic; flagellum arising from one side of anterior end; vacuole anterior, circular or triangular in outline; movement creeping as in Petalomonas.

Distribution, cosmopolitan.

#### TABLE OF SPECIES.

A¹ Oval, narrowed anteriorly.
- B¹ Frequenting digestive tract of frogs and toads, also stagnant water(?), nucleus posterior . . . . . 1. **S. pusilla**
- B² Frequenting digestive trace of *Molge vulgaris*,—nucleus anterior . . . . . . . . 2. **S. dobellii**

A² Elongately oval with broadly rounded ends, not distinctly narrowed, anteriorly . . . . . . . 3. **S. major**

1. **S. pusilla** Stein (Fig. 14, Pl. XXIII).

Oval, distinctly narrowed anteriorly and rounded, or rarely fusiform or emarginate; flagellum 1¼ times length of body; nucleus posterior, rarely central.

L. 7.5-20$\mu$. D. 7-8$\mu$.

Distribution, Europe. Intestine of frogs and toads.

Lemmermann notes *Copromonas subtilis* Dobell as a synonym of this, while he suggests that *Sytomonas pusilla* Klebs may represent a distinct genus, the cell being oval, truncate anteriorly, nucleus central, flagellum scarcely as long as body, cytopharynx absent. In cultures of decaying algae.

2. **S. dobelli** n.sp. (Fig. 15, Pl. XXIII).

Oval, distinctly narrowed anteriorly; flagellum 1½ times length of body; nucleus anterior.

L. 7-10$\mu$. D. 3-4$\mu$.

Distribution, Europe. Intestine of *Molge vulgaris* L., one of the Salamanders.

It seems evident that this form referred by Lemmermann doubtfully to *S. major* should be considered as a distinct species by reason of difference in host, general size, position of nucleus, etc. Therefore it is fitting that it bear the name of the investigator by whom it was discovered.

3. **S. major** (Berliner), (Fig. 1, Pl. XXIV).

Elongately oval, broadly rounded at the ends; flagellum 1¼ times the length of the body; nucleus central.

L. 20$\mu$. D. 8$\mu$.

Distribution. Europe. Digestive tract of *Lacerta viridis* Gessn., the small green lizard.

### 4. Gen. PERANEMA Stein.

Form spindle shaped, narrowed anteriorly; strongly metabolic; flagellum longer than body; pharynx prominent; rod-like organ present; pellicula striate spirally; nucleus central; paramylon present; movement a slow swimming one accompanied by decided metabolic contractions of the body.

#### TABLE OF SPECIES.

A¹ Fusiform or cylindrical, flagellum 1-1½ times length of body, L.22-70$\mu$. . . . . . . . 1. **P. trichophorum**

A² Elongately spherical, flagellum 2½-3 times length of body, L.8-15$\mu$. . . . . . . . . 2. **P. granulifera**

*1. **P. trichophorum** (Ehrenb.) (Fig. 2, Pl. XXIV).

Fusiform or cylindrical; periplast spirally striate, the striae

formed of numerous elevations apparently developed as short hairs; flagellum 1-1½ times length of body.

L. 22-70$\mu$. D. 12-20$\mu$.

Distribution, cosmopolitan. In stagnant water generally in company with *Euglena*. The presence of the rod-like organ serves to distinguish the species from members of the genus *Astasia*.

Jennings in his study of the Protozoa of Lake Erie noted under the name of *Astasia trichophora* Ehrb., a form which may be referred to this species. Conn in The Protozoa of Connecticut suggests that the extreme variation in the forms indicates several species in the genus.

2. **P. granulifera** Penard (Fig. 3, Pl. XXIV).

Elongately spherical; periplast covered with granules; flagellum 2½-3 times length of body.

L. 8-15$\mu$. D. (?).

Distribution, Europe. Stagnant pools.

## 5. Gen. URCEOLUS Meresch.

Form flask shaped with contracted neck; decidedly metabolic; posterior end rounded; anterior end forming a funnel shaped peristome extending into a pharynx and reaching to the posterior third of the body; flagellum somewhat longer than body; rod-like organ present; pellicula either striate spirally or smooth surrounded with mucous containing minute foreign substances; principal vacuole with a small accessory contractile vacuole and with a long excretory canal; movement creeping. Four species.

Habitat, fresh water and marine.

Distribution, cosmopolitan (?).

### TABLE OF SPECIES.

A1 Periplast without a gelatinous layer in which is imbedded numerous minute granules of sand.
- B1 Periplast striated.
  - C1 Posterior end with a short tip; prominent spiral carinae not present . . . . . . **1. U. cyclostomus**
  - C2 Posterior end developed into an elongate tip; several prominent spiral carinae . . . . **2. U. costatus**
- B2 Periplast not striated . . . . . . **3. U. alenizini**

A2 Periplast with gelatinous layer in which are imbedded numerous minute granules of sand . . . . . **4. U. sabulosus**

*1. **U. cyclostomus** (Stein) (Fig. 4, Pl. XXIV).

Fusiform with anterior end normally flask-like in form; periplast spirally striate; flagellum slightly longer than body; prominent rod-like organ present.

L. 26-50$\mu$. D. 17-30$\mu$.

Distribution, cosmopolitan(?). Stagnant pools.

Ohio, decaying vegetation from Biemiller's Cove, Sandusky (Landacre).

2. **U. costatus** Lemm. (Fig. 5, Pl. XXIV).

Fusiform with pointed tip and several prominent spiral carinae; flagellum less than length of body.

L. 35-40$\mu$. D. 12-14$\mu$.

Distribution, Europe. Ponds containing much vegetation and also in Plankton.

3. **U. alenizini** Meresch. (Fig. 6, Pl. XXIV).

Broadly fusiform with more or less blunt ends, the anterior end truncate, posterior rounded; periplast smooth; flagellum slightly longer than body.

L. 39$\mu$. D. 24$\mu$.

Distribution, Europe. Stagnant water and water from refuse material.

4. **U. sabulosus** Stokes (Fig. 7, Pl. XXIV).

Broadly fusiform, somewhat widened anteriorly and obliquely truncated with contracted neck-like process of the cytopharynx; covered with gelatinous substance containing numerous minute granules; flagellum as long or longer than body.

L. 58$\mu$. D.(?).

Distribution, North America. Fresh water with algae.

This species placed originally in the genus *Urceolus* by Stokes was later transferred by him to a new genus *Urceolopsis*. The general structure, however, suggests that it may be replaced in the former genus at least for the present. It swims rapidly.

## 6. Gen. HETERONEMA (Duj.) Stein.

Form elongate, or spherical, usually assuming a more or less twisted appearance; decidedly metabolic; anterior end pointed; provided with two flagella the length of the anterior from 1-2

times the length of the body, the length of the posterior from ½-1 times the length of the body; principal vacuole with small accessory vacuole; rod-like organ slightly developed; movement slow gliding, rarely a rotating free-swimming movement.

Habitat, fresh water.

### TABLE OF SPECIES.

| | |
|---|---|
| A¹ Periplast without distinct spiral or longitudinal striations. | |
| B¹ Cells normally straight. | |
| C¹ Anterior and posterior ends blunt . . | 1. **H. acus** |
| C² Anterior and posterior ends sharply pointed | 2. **H. acutissimum** |
| B² Cells curved or twisted. | |
| C¹ Curved or sickle like in form . . . | 3. **H. tremulum** |
| C² Twisted into a form resembling spiral threads of a screw . . . . . . | 4. **H. spirale** |
| A² Periplast with distinct spiral or longitudinal striations. | |
| B¹ Periplast longitudinally striate, length approximately 250$\mu$. . . . . . . . | 5. **H. mutabile** |
| B² Periplast spirally striate, length 35-60$\mu$. | |
| C¹ Comparatively long, fusiform, twisted . | 6. **H. klebsii** |
| C² Comparatively short, spherical or oval, not twisted. | |
| D¹ Secondary flagellum shorter than the body | 7. **H. nebulosum** |
| D² Secondary flagellum longer than the body | 8. **H. globiferum** |

1. **H. acus** (Ehrenb.) (Fig. 8, Pl. XXIV).

Fusiform with rounded ends; periplast weakly striate spirally; primary flagellum slightly longer than body; secondary flagellum about ½ length of body.

L. 45-50$\mu$. D. 8-20$\mu$.

Distribution, cosmopolitan (?). Stagnant pools.

2. **H. acutissimum** Lemm. (Fig. 9, Pl. XXIV).

Elongately fusiform with pointed ends; periplast smooth; primary flagellum as long as body; secondary flagellum 1½-2 times as long as body.

L. 17$\mu$. D. 2.5-3$\mu$.

Distribution, Europe. Pools with aquatic vegetation.

3. **H. tremulum** Zach. (Fig. 10, Pl. XXIV).

Slightly lunate or curved, narrowed in front, broadly rounded posteriorly; periplast smooth; primary flagellum somewhat longer than body; secondary flagellum ¼ as long as body.

L. 40$\mu$. D. (?).

Distribution, Europe. Stagnant pools.

4. **H. spirale** Klebs (Fig. 11, Pl. XXIV).

Cylindrical with 5-6 prominent spiral ridges; periplast smooth; primary flagellum 2 times length of body; secondary flagellum about ¾ length of body.

L. 42$\mu$. D. 24-30$\mu$.

Distribution, Europe. Stagnant pools.

*5. **H. mutabile** (Stokes) (Fig. 1, Pl. XXV).

Oval to elongately cylindrical, extremely metabolic; periplast longitudinally striate; primary flagellum ¼ length of body; secondary flagellum as long as body.

L. 250$\mu$. D. (?).

Distribution, North America. Cypress swamps S. Florida.

Stokes originally placed this in the genus *Zygoselmis* Duj. He notes that "The incessant alterations in the form of this curious infusorian are indescribable. The food is indiscriminately animal or vegetable. The endoplasm of the individuals observed contained desmids, diatomes, and in a single instance a small rotifer."

A form which is referred to this species with some hesitation was taken in a culture obtained from the Kokosing River at Gambier, O.

6. **H. klebsii** Senn (Fig. 2, Pl. XXV).

Fusiform, resembling a triangular prism somewhat twisted; longitudinally (?) striate; primary flagellum somewhat longer than the body; secondary flagellum slightly shorter than the body.

L. 52-58$\mu$. D. 13$\mu$.

Distribution, Europe. Peat swamps in Harz Mountains, Germany.

7. **H. nebulosum** (Duj.) (Fig. 3, Pl. XXV).

Spherical or oval, with narrow, clear, anterior end; periplast decidedly striate spirally; primary flagellum 2 times length of body; secondary flagellum ½ length of body.

L. 40-57$\mu$. D. 10-30$\mu$.

Distribution, Europe.

8. **H. globiferum** Stein (Fig. 4, Pl. XXV).

Oval, rounded or emarginate posteriorly; periplast striate

spirally; primary flagellum 2 times length of body; secondary flagellum slightly longer than body.

L. 39$\mu$. D. (?).

Distribution, Europe. Stagnant pools.

### 7. Gen. TROPIDOSCYPHUS Stein.

Form oval, pointed anteriorly and posteriorly; often slightly metabolic; 8 prominent longitudinal carinae; anterior flagellum long, posterior flagellum short; principal vacuole with smaller accessory vacuole; rod-like organ absent; movement creeping.

Habitat, fresh water.

Distribution, cosmopolitan.

The genus consists of two species.

#### TABLE OF SPECIES.

| | |
|---|---|
| A[1] Anterior end of cytopharynx with two prominent lobes; L. 50-60$\mu$. . . . . . . . . | **1. T. octocostatus** |
| A[2] Anterior end of cytopharynx rounded . . . | **2. T. cyclostomus** |

1. **T. cyclostomus** Senn (Fig. 5, Pl. XXV).

Broadly fusiform, with anterior end curved at extremity into a lip-like process; pointed posteriorly; 4 well developed longitudinal carinae present; primary flagellum 1½ times length of body; secondary flagellum 2/3 length of body.

L. 16$\mu$. D. 10-14$\mu$.

Distribution, Europe. Thus far found only in a small stream near Halle, Germany.

2. **T. octocostatus** Stein (Fig. 6, Pl. XXV).

Broadly fusiform, emarginate anteriorly with two lateral points; pointed posteriorly; primary flagellum 1½-2 times length of body; secondary flagellum 1/3-½ length of body.

L. 35-63$\mu$. D. (?).

Distribution, Europe. Pools rich in aquatic vegetation.

### 8. Gen. NOTOSOLENUS Stokes.

Form oval approaching rectangular; strongly compressed dorso-ventrally; concave dorsally, convex ventrally; body rigid, not metabolic; two flagella, the length of the anterior 1-1½ times length of body, length of posterior 1/3 length of body; mouth oval; pellicula smooth; principal vacuole with accessory contractile

vacuole anteriorly on right side of body; nucleus on left middle part of body; rod-like organ not evident; movement creeping in irregular manner.

Habitat, fresh water. Three species.

Distribution, cosmopolitan(?).

TABLE OF SPECIES.

A[1] Broadly oval or circular in outline; posterior end rounded.
  B[1] Oval, median furrow narrow, occupying about ⅓ diameter of body . . . . . . . 1. **N. apocamptus**
  B[2] Circular, median furrow broad, occupying about ¾ diameter of body . . . . . . . 2. **N. orbicularis**
A[2] Triangular in outline, emarginate at posterior end which is the broadest part of the body . . . . . . 3. **N. sinuatus**

*1. **N. apocamptus** Stokes (Fig. 7, Pl. XXV).

Oval, pointed anteriorly, broadly rounded posteriorly; dorsal median furrow narrow; primary flagellum about 1½ times length of body; secondary flagellum ½ length of body.

L. 6.5-10$\mu$. D.(?).

Distribution, cosmopolitan N. America, Germany, Senn. Standing water with Myriophyllum.

Hamilton, O. Storage reservoir.

2. **N. orbicularis** Stokes (Fig. 8, Pl. XXV).

Oval to circular in outline, rounded at ends; median dorsal furrow broad approximating ¾ diameter of body; primary flagellum 1½ times length of body; secondary flagellum ½ length of body.

L. 10-11.5$\mu$. D.(?) (.

Distribution, North America. Near bottom of shallow pools.

3. **N. sinuatus** Stokes (Fig. 9, Pl. XXV).

More or less triangular, broadest posteriorly with end emarginate; dorsal furrow narrow, slightly carinate anteriorly; primary flagellum 1½ times length of body; secondary flagellum ½ length of body.

L. 22.5$\mu$. D. 17$\mu$.

Distribution, North America. Standing water with dead leaves.

### 9. Gen. ANISONEMA Dujardin.

Form oval, distinctly compressed dorso-ventrally; a ventral furrow extends backward and to the right from the mouth; body

rigid, not metabolic; two flagella, the anterior about as long as the body, the posterior considerably longer; pellicula smooth or striate in longitudinal spirals; principal vacuole with accessory contractile vacuole; nucleus on right side of body; movement in a slow creeping or a quick jerking manner.

Habitat, fresh water and marine.

Distribution, cosmopolitan.

TABLE OF SPECIES.

$A^1$ Length not more than 2 times diameter.

$B^1$ Elongately oval; primary flagellum approximately as long as body . . . . . . 1. **A. ovale**

$B^2$ Broadly oval; primary flagellum 2 times length of body. . . . . . . . 2. **A. emarginatum**

$A^2$ Length nearly 3 times or more than 3 times the diameter.

$B^1$ Length 25-60μ.

$C^1$ Pointed anteriorly; length 25-40μ. . . 3. **A. acinus**

$C^2$ Broadest anteriorly; length 60μ. . . 4. **A. truncatum**

$B^2$ Length 11μ.; broadly fusiform . . . . 5. **A. pusillum**

*1. **A. ovale** Klebs (Fig. 10, Pl. XXV).

Oval, rigid, emarginate anteriorly; periplast smooth; primary flagellum about as long as body; secondary flagellum about 1½ times as long as body.

L. 11μ. D. 7μ.

Distribution, Europe and North America. Standing water. Gambier, O. (McElroy Farm).

Var *latum* Klebs with L. 12μ, D. 10μ, broad and emarginate posteriorly.

2. **A. emarginatum** Stokes (Fig. 11, Pl. XXV).

Broadly oval, rigid, emarginate anteriorly; periplast smooth; primary flagellum about 2 times length of body; secondary flagellum about 2½ times length of body.

L. 14μ. D.(?).

Distribution, North America. Standing water with *Myriophyllum*, etc.

*3. **A. acinus** Duj. (Fig. 12, Pl. XXV).

Oval, rigid, noticeably flattened; periplast smooth or weakly striate; left side of ventral furrow prominent, thickened anteriorly; primary flagellum as long as body; secondary flagellum about 2 times length of body.

L. 25-40$\mu$. D. 16-22$\mu$.

Distribution, cosmopolitan. Standing water and Plankton.

Landacre notes the species from Biemiller's Cove, Sandusky, O., in "towings."

4. **A. truncatum** Stein (Fig. 13, Pl. XXV).

Oval, broadest anteriorly, rigid; periplast smooth; primary flagellum as long as body; secondary flagellum more than twice as long as body.

L. 60$\mu$. D. 20$\mu$.

Distribution, Europe. Standing water.

5. **A. pusillum** Stokes (Fig. 14, Pl. XXV).

Broadly oval, flattened, convex dorsally, longitudinally striate, concave ventrally; primary flagellum as long as body; secondary flagellum about 3 times length of body.

L. 11$\mu$. D.(?).

Distribution, North America. Pond water.

The movement of the form is noted by Stokes as a slow oscillating one.

### 10. Gen. PLOEOTIA Dujardin.

Form broadly oval, pointed behind; two flagella, the posterior being much longer than the anterior; provided with carinae which, beginning at the posterior end, extend toward the anterior end in a more or less spiral manner; nucleus central; movement creeping.

Habitat, marine.

Distribution, cosmopolitan. Two species.

#### TABLE OF SPECIES.

A[1] Somewhat compressed, posterior end acuminate, length less than twice the diameter . . . . . . 1. **P. vitrea**

A[2] Radial, not compressed, posterior end not acuminate, length more than twice the diameter . . . . . 2. **P. marina**

1. **P. vitrea** Duj. (Fig. 1, Pl. XXVI).

Broadly oval with acute tip slightly uncinate and with 8 longitudinal carinae; primary flagellum about as long as body; secondary flagellum about 2 times length of body.

L. 30$\mu$. D. 20$\mu$.

Distribution, cosmopolitan(?). Salt water.

2. **P. marina** n. sp. (Fig. 2, Pl. XXVI).

Fusiform, rigid, not compressed; 8 longitudinal carinae slightly spiral; cell transparent; primary flagellum 2/3 length of body; secondary flagellum 2 times length of body.

L. 50μ. D. 23μ.

Distribution, cosmopolitan. Two species.

Woods Holl, Mass.

This form was described and illustrated in a well drawn figure by Calkins (U. S. Fish Com. Bull., p. 426, 1901—printed 1902) under the name *Anisonema vitrea* Duj., a species which belongs to the genus *Ploeotia*. It differs from *P. vitrea* by the characters noted above. The length of its secondary flagellum eliminates it from the genus *Tropidoscyphus*, while the presence of keel-like ribs or carinae removes it from the genus *Anisonema*. The genus *Ploetia* is founded on a form laterally compressed. It seems better, however, to remove such a qualification and place it here rather than make a new genus for its reception.

## 11. Gen. METANEMA Klebs.

Form oval, metabolic comparatively short, compressed dorsoventrally; two flagella of approximately equal length, the posterior, however, not trailing directly behind, but carried to one side during swimming.

Habitat, fresh water.

Distribution, cosmopolitan. Two species.

### TABLE OF SPECIES.

| | |
|---|---|
| A¹ Pellicula smooth . . . . . . . . | **1. M. variabile** |
| A² Pellicula with distinct spiral striae . . . . | **2. M. striatum** |

1. **M. variabile** Klebs (Fig. 3, Pl. XXVI).

Short cylindrical, decidedly metabolic, rounded on ends; periplast smooth; primary flagellum as long as body; secondary flagellum somewhat longer than body.

L. 14-16μ. D. 9-12μ.

Distribution, Europe. Standing water.

2. **M. striatum** Klebs (Fig. 4, Pl. XXVI).

Cylindrical, slightly metabolic, flattened, emarginate anteriorly; periplast spirally striate; primary flagellum slightly longer

than body; secondary flagellum a little longer than primary flagellum.

L. 15$\mu$. D. 7$\mu$.

Distribution, Europe. Standing water.

### 12. Gen. MARSUPIOGASTER Schewiakoff.

Rigid, elongately striate; periplast thin; 1 primary and 1 secondary flagellum, the latter equal at least in length to the former, and both arising from a pocket-like excavation; reproduction unknown; swimming with a trembling movement. A single species.

1. **M. striata** Schew. (Fig. 5, Pl. XXVI).

Oval, flattened, anteriorly obliquely truncate; primary flagellum as long as body; secondary flagellum 1½ times length of body.

L. 27$\mu$. D. 15$\mu$.

Distribution, Sandwich Islands (Oahu).

### 13. Gen. ENTOSIPHON Stein.

Form oval, short, slightly compressed; ventral furrow absent; two flagella, each approximately the length of the body, arising from the depression at anterior end; mouth anterior opening into a tube through which nourishment is taken in the form of small granules; pellicula with longitudinal carinae or furrows; principal vacuole with several small accessory contractile vacuoles; movement creeping, often with a trembling motion.

Habitat, fresh water and marine.

Distribution, cosmopolitan. Three species.

TABLE OF SPECIES.

A[1] Pellicula with distinct longitudinal furrows; rod-like organ attaining posterior part of body.

B[1] Furrows 4-8 in number . . . . . 1. **E. sulcatum**

B[2] Furrows 10-12 in number . . . . . . 2. **E. ovatum**

A[2] Pellicula with only indistinct furrows; rod-like organ extending only half the length of the body . . . 3. **E. obliquum**

*1. **E. sulcatum** (Duj.) (Fig. 6, Pl. XXVI).

Oval, emarginate anteriorly; 4-8 longitudinal striae; primary flagellum about as long as body; secondary flagellum slightly longer than body; rod-like organ attaining posterior part of the body.

L. 20-25$\mu$. D. 10-15$\mu$.

Distribution, cosmopolitan. Standing water.

Var. *acuminatum* Lemm. is oval, broadened posteriorly, with sharp tip.

Ohio, jar of decaying *Nelumbo* from E. Harbor, Lake Erie (Jennings). Algae from logs of basket factory, Sandusky Bay, and also from College Lake, Columbus (Landacre).

*2. **E. ovatum** Stokes (Fig. 7, Pl. XXVI).

Oval, emarginate anteriorly; 10-12 longitudinal striae; primary flagellum about as long as body; secondary flagellum approximately 2 times length of body; rod-like organ attaining posterior part of body.

L. 25-28$\mu$. D. 10-12$\mu$.

Distribution, North America. Infusion of dead leaves.

Hamilton, O., storage reservoir; Cincinnati, O., upper storage reservoir.

3. **E. obliquum** Klebs (Fig. 8, Pl. XXVI).

Oval, broadest anteriorly, end diagonally truncate; periplast weakly striate longitudinally; rod-like organ only attaining the middle of the body; primary flagellum about length of body; secondary flagellum 1½ times length of body.

L. 15$\mu$. D. 7.5$\mu$.

Distribution, Europe. Standing water.

### 14. Gen. CLAUTRIAVIA Massart.

Form oval, free swimming; possessing a single flagellum directed posteriorly instead of anteriorly; pellicula rigid; mouth anterior, ventral; vacuole posterior left area of body; paramylon evident. Two species.

Reproduction by longitudinal division.

Distribution, Belgium.

This genus undoubtedly represents a form belonging to the subfamily Anisonemeae in which the anterior flagellum has been lost in the process of the evolution of the species. The first representatives were found by Massart from a culture of algae obtained at Nieuport on the Belgian coast from a fresh water ditch. While noted as free swimming, the movements are rather "tad-pole" like, dependent on the posterior flagellum.

The genus has not been found in America and if later discovered will probably be noted from brackish water ditches near the coast.

### TABLE OF SPECIES.

A[1] Length 18-20$\mu$.; diameter not greatest posteriorly; flagellum not longer than body . . . . . . . 1. **C. mobilis**
A[2] Length 7-8$\mu$.; diameter greatest posteriorly; flagellum 3-4 times length of body . . . . . . . . 2. **C. parva**

1. **C. mobilis** Mass. (Fig. 9, Pl. XXVI).

Oval approaching cylindrical; rigid; cytopharynx opening anteriorly and ventral in position; nucleus right, posterior part of cell; primary flagellum absent; secondary flagellum 1½ times length of body.

L. 18-20$\mu$. D. 12-13$\mu$.

Distribution, Belgium. Among algae in fresh water ditch on coast near Nieuport.

2. **C. parva** Schout. (Fig. 10, Pl. XXVI).

Oval, widest posteriorly, rigid; cytopharynx opening anteriorly and ventrally; primary flagellum absent; secondary flagellum 3 times length of body.

L. 9-10$\mu$. D. 7-8$\mu$.

Distribution, Belgium. Among algae in fresh water ditch coast near Nieuport.

## 15. Gen. DINEMA Perty.

Elongately oval, rounded at both ends, slowly metabolic; ectoplasm with granules arranged spirally; two flagella, the anterior about as long as the body and not attenuate at end; the posterior about twice as long as body and decidedly attenuate at end; rod-like organ present; pellicula striate spirally; principal vacuole with small accessory contractile vacuoles; nucleus large, situated somewhat behind the middle of the body; movement creeping.

A single species.

Habitat, fresh water.

Distribution, cosmopolitan.

**1. D. griseolum** Perty (Fig. 11, Pl. XXVI).

Elongately oval with rounded ends; periplast spirally striate with ectoplasm containing granules arranged spirally; primary flagellum as long as body; secondary flagellum 1½ times length of body.

L. 76-80$\mu$. D. 30-40$\mu$.

PLATE XII

1. *Euglena viridis* Ehrenb., x 500 (Walton).
2. *Euglena geniculata* Dujard., x 500 (Dangeard).
3. *Euglena olivacea* Schmitz, x 500 (Lemmermann).
4. *Euglena oblonga* Schmitz, x 500 (Schmitz).
5. *Euglena elongata* Schw., x 500 (Schewiakoff).
6. *Euglena minima* Francé, x 1000 (Francé).
7. *Euglena pisciformis* Klebs, var. *minor*, x 1000 (Walton).
8. *Euglena terricola* (Dangeard), x 500 (Lemmermann).
9. *Euglena splendens* Dangeard, x 500 (Dangeard).
10. *Euglena sanguinea* Ehrenberg, x 500 (Haase).
11. *Euglena rubra* Hardy, x 500 (Hardy).
12. *Euglena haematodes* (Ehrenberg), x 500 (From description).
13. *Euglena velata* Klebs, x 500 (Dangeard).

PLATE XIII

1. *Euglena sociabilis* Dangeard, x 500 (Dangeard).
2. *Euglena granulata* (Klebs), x 500 (Hübner).
3. *Euglena polymorpha* Dangeard, x 500 (Dangeard).
4. *Euglena proxima* Dangeard, x 500 (Dangeard).
5. *Euglena caudata* Hübner, x 500 (Lemmermann).
6. *Euglena flava* Dangeard, x 500 (Lemmermann).
7. *Euglena orientalis* Kashyop, x 500 (From description).
8. *Euglena variabilis* Klebs, x 500 (Klebs).
9. *Euglena gracilis* Klebs, x 500 (Lemmermann).
10. *Euglena torta* Stokes, x 500 (Stokes).

PLATE XIV

1. *Euglena deses* Ehrenberg, x 500 (Walton).
2. *Euglena mutabilis* Schmitz, x 500 (Schmitz).
3. *Euglena spiroides* Lemmermann, x 500 (Lemmermann).
4. *Euglena oxyuris* Schmarda, x 250 (Walton).
5. *Euglena simulacra* n. sp., x 500 (Walton).
6. *Euglena intermedia* (Klebs), x 500 (Lemmermann).
7. *Euglena tripteris* Dujard., x 500 (Walton).
8. *Euglena acus* Ehrenberg, x 500 (Walton).
9. *Euglena limnophila* Lemmermann, x 500 (Lemmermann).
10. *Euglena acutissima* Lemmermann, x 500 (Lemmermann).

## PLATE XV

1. *Euglena spirogyra* Ehrenberg, x 500 (Walton).
2. *Euglena fusca* (Klebs), x 500 (Hübner).
3. *Euglena ehrenbergii* Klebs, x 250 (Lemmermann).
4. *Euglena truncata* n. sp., x 250 (Walton).
5. *Euglena quartana* Moroff, x 500 (Maroff).
6. *Leptocinclis ovum* (Ehrenberg), x 1000 (Stein).
7. *Leptocinclis sphagnophila* Lemmermann, x 1000 (Zacharias).
8. *Leptocinclis steinii* Lemmermann, x 1000 (Stein).
9. *Leptocinclis buetschlii* Lemmermann, x 1000 (Bütschli).
10. *Leptocinclis teres* (Schmitz), x 1000 (Schmitz).

## PLATE XVI

1. *Leptocinclis fusiformis* (Carter), x 1000 (Lemmermann).
2. *Leptocinclis acicularis* Francé, x 1000 (Francé).
3. *Leptocinclis texta* (Dujard.), x 1000 (Lemmermann).
4. *Leptocinclis globosa* Francé, x 1000 (Francé).
5. *Leptocinclis marssonii* Lemmermann, x 1000 (Lemmermann).
6. *Phacus anacoelus* Stokes, x 500 (Stokes).
7. *Phacus alata* Klebs, x 500 (Dangeard).
8. *Phacus orbicularis* Hübner, x 500 (Hübner).
9. *Phacus pleuronectes* (Mull.) x 500 (Lemmermann).
10. *Phacus triqueter* (Ehrenb.), x 500 (Stein).

## PLATE XVII

1. *Phacus suecica* Lemmermann, x 500 (Lemmermann).
2. *Phacus longicauda* (Ehrenb.), x 500 (Lemmermann).
3. *Phacus caudata* Hübner, x 500 (Hübner).
4. *Phacus acuminata* Stokes, x 500 (Stokes).
5. *Phacus brevicaudata* (Klebs), x 500 (Lemmermann).
6. *Phacus stokesii* Lemmermann, x 500 (Lemmermann).
7. *Phacus hispidula* (Eichw.), x 500 (Stein).
8. *Phacus monilata* Stokes, x 500 (Stokes).
9. *Phacus pyrum* (Ehrenb.), x 500 (Lemmermann).
10. *Phacus nordstedtii* Lemmermann, x 500 (Lemmermann).
11. *Phacus setosa* Francé, x 500 (Francé).
12. *Phacus striata* Francé, x 500 (Francé).
13. *Phacus oscillans* Klebs, x 500 (Klebs).
14. *Phacus parvula* Klebs, x 500 (Lemmermann).
15. *Phacus clavata* Dangeard, x 500 (Lemmermann).
16. *Phacus pusilla* Lemmermann, x 500 (Hübner).
17. *Phacus dangeardii* Lemmermann, x 500 (Dangeard).

## PLATE XVIII

1. *Cryptoglena pigra* Ehrenb., x 1000 (Lemmermann).
2. *Trachelomonas volvocina* Ehrenb., x 1000 (Lemmermann).
3. *Trachelomonas perforata* Awerinz., x 1000 (Awerinzew).
4. *Trachelomonas intermedia* Dangeard, x 1000 (Dangeard).
5. *Trachelomonas verrucosa* Stokes, x 1000 (Palmer).
6. *Trachelomonas rugulosa* Stein, x 1000 (Stein).
7. *Trachelomonas vermiculosa* Palmer x 1000 (Palmer).
8. *Trachelomonas stokesiana* Palmer, x 1000 (Palmer).
9. *Trachelomonas spiculifera* Palmer, x 1000 (Palmer).
10. *Trachelomonas vestita* Palmer, x 1000 (Palmer).
11. *Trachelomonas bernardi* Wolos., x 1000 (Woloszynska).
12. *Trachelomonas teres* Maskell, x 1000 (Maskell).
13. *Trachelomonas oblonga* Lemmermann, x 1000 (Lemmermann).

## PLATE XIX

1. *Trachelomonas crebea* Kellicott, x 1000 (Palmer).
2. *Trachelomonas lemmermanii* Wolosz., x 1000 (Woloszynska).
3. *Trachelomonas ovalis* v. Daday, x 1000 (v. Daday).
4. *Trachelomonas similis* Stokes, x 1000 (Stokes).
5. *Trachelomonas volzii* Lemmermann, x 1000 (Lemmermann).
6. *Trachelomonas eurystoma* Stein, x 1000 (Stein).
7. *Trachelomonas incerta* Lemmermann, x 1000 (Schulz).
8. *Trachelomonas africana* Fritsch, x 1000 (Fritsch).
9. *Trachelomonas reticulata* Klebs, x 1000 (Lemmermann).
10. *Trachelomonas euchlora* (Ehrenb.), x 1000 (Stein).
11. *Trachelomonas conspersa* Pascher, x 1000 (Pascher).
12. *Trachelomonas annulata* v. Daday, x 250 (v. Daday).

## PLATE XX

1. *Trachelomonas minor* Palmer, x 1000 (Palmer).
2. *Trachelomonas affinis* Lemmermann, x 500 (Lemmermann).
3. *Trachelomonas volgensis* Lemmermann, x 1000 (Zykoff).
4. *Trachelomonas acuminata* (Schmarda), x 500 (v. Daday).
5. *Trachelomonas urceolata* Stokes, x 500 (Stokes).
6. *Trachelomonas fluviatilis* Lemmermann, x 1000 (Lemmermann).
7. *Trachelomonas schauinslandii* Lemmermann, x 1000 (Lemmermann).
8. *Trachelomonas ensifera* v. Daday, x 250 (v. Daday).
9. *Trachelomonas acanthostoma* Stokes, x 500 (From description).
10. *Trachelomonas armata* Ehrenberg, x 500 (Lemmermann).
11. *Trachelomonas raciborskii* Wolosz., x 500 (Woloszynska).
12. *Trachelomonas globularis* (Awerinz.), x1000 (Awerinzew).
13. *Trachelomonas westii* Wolosz., x 1000 (Woloszynska).
14. *Trachelomonas americana* Lemmermann, x 1000 (Palmer).
15. *Trachelomonas aegyptiaca* Lemmermann, x 500 (Schmarda).
16. *Trachelomonas piscatoris* (Fisher), x 500 (Lemmermann).

## PLATE XXI

1. *Trachelomonas setosa* Zygoff, x 500 (Zygoff).
2. *Trachelomonas spinosa* Stokes, x 500 (Stokes).
3. *Trachelomonas hispida* (Perty), x 500 (Dangeard).
4. *Trachelomonas obtusa* Palmer, x 500 (Palmer).
5. *Trachelomonas horrida* Palmer, x 500 (Palmer).
6. *Trachelomonas saccata* Lemmermann, x ? (Lemmermann).
7. *Trachelomonas bulla* Stein, x 500 (Stein).
8. *Trachelomonas obovata* Stokes, x 500 (Stokes).
9. *Trachelomonas helvetica* Lemmermann, x ? (Lemmermann).
10. *Trachelomonas caudata* (Ehrenb.), x 500 (Stein).
11. *Ascoglena vaginocola* Stein, x 500 (Stein).
12. *Ascoglena amphoroides* (Francé), x 500 (Francé).
13. *Colacium vesiculosum* Ehrenb., x 500 (Walton).
14. *Colacium arbuscula* Stein, x 500 (Stein).
15. *Colacium calvum* Stein, x 500 (Stein).
16. *Eutreptia viridis* Perty, x 500 (Lemmermann).

## PLATE XXII

1. *Eutreptia lanowii* Steuer, x 500 (Steuer).
2. *Astasia lagenula* (Schew.), x 1000 (Schewiakoff).
3. *Astasia inflata* Dujard, x 1000 (Klebs).
4. *Astasia ocellata* Khawk., x 1000 (Khawkine).
5. *Astasia klebsii* Lemmermann, x 500 (Klebs).
6. *Astasia dangeardii* Lemmermann, x 1000 (Lemmermann).
7. *Astasia curvata* Klebs, x 1000 (Lemmermann).
8. *Astasia captiva* Beauch., x 1000 (Beauchamp).
9. *Astasia mobilis* (Rehberg), 1000 (Alexeieff).
10. *Menoidium falcatum* Zach., x 250 (Zacharias).
11. *Menoidium tortuosum* (Stokes), x 500 (Stokes).
12. *Menoidium pellucidum* Perty, x 500 (Lemmermann).
13. *Menoidium incurvum* (Fres.), x 250 (Stein).
14. *Distigma protens* Ehrenb., x 500 (Lemmermann).
15. *Sphenomonas teres* (Stein), x 500 (Lemmermann).
16. *Sphenomonas quadrangularis* Stein, x 500 (Stein).

## PLATE XXIII

1. *Euglenopsis vorax* Klebs, x 1000 (Lemmermann).
2. *Petalomonas mediocanellata* Stein, x 1000 (Klebs).
3. *Petalomonas angusta* (Klebs), x 1000 (Klebs).
4. *Petalomonas inflexa* Klebs, x 1000 (Stein).
5. *Petalomonas sinuata* (Stein), x 1000 (Stein).
6. *Petalomonas sexlobata* Klebs, x 1000 (Lemmermann).
7. *Petalomonas steinii* Klebs, x 1000 (Lemmermann).
8. *Petalomonas carinata* (Francé), x 1000 (Francé).
9. *Petalomonas abscissa* (Dujard), x 1000 (Lemmermann).
10. *Petalomonas mira* Awerinz., x 1000 (Awerinzew).

11. *Petalomonas quadrilineata* Penard, x 1000 (Penard).
12. *Petalomonas sulcata* Stokes, x 1000 (From description).
13. *Petalomonas alata* Stokes, x 1000 (From description).
14. *Scytomonas pusilla* Stein, x 1000 (Lemmermann).
15. *Scytomonas dobelli* n. sp., x 1000 (Lemmermann).

## PLATE XXIV

1. *Scytomonas major* (Berliner), x 1000 (Berliner).
2. *Peranema trichophorum* (Ehrenb.), x 1000 (Lemmermann).
3. *Peranema granulifera* Penard, x 1000 (Penard).
4. *Urceolus cyclostomus* (Stein), x 1000 (Lemmermann).
5. *Urceolus costatus* Lemmermann, x 1000 (Stein).
6. *Urceolus alenizini* Mereschk., x 1000 (Mereschkonsky).
7. *Urceolus sabulosus* Stokes, x 1000 (Stokes).
8. *Heteronema acus* (Ehrenb.), x 1000 (Lemmermann).
9. *Heteronema acutissimum* Lemmermann, x 1000 (Stokes).
10. *Heteronema tremulum* Zacharias, x 1000 (Zacharias).
11. *Heteronema spirale* Klebs, x 1000 (Lemmermann).

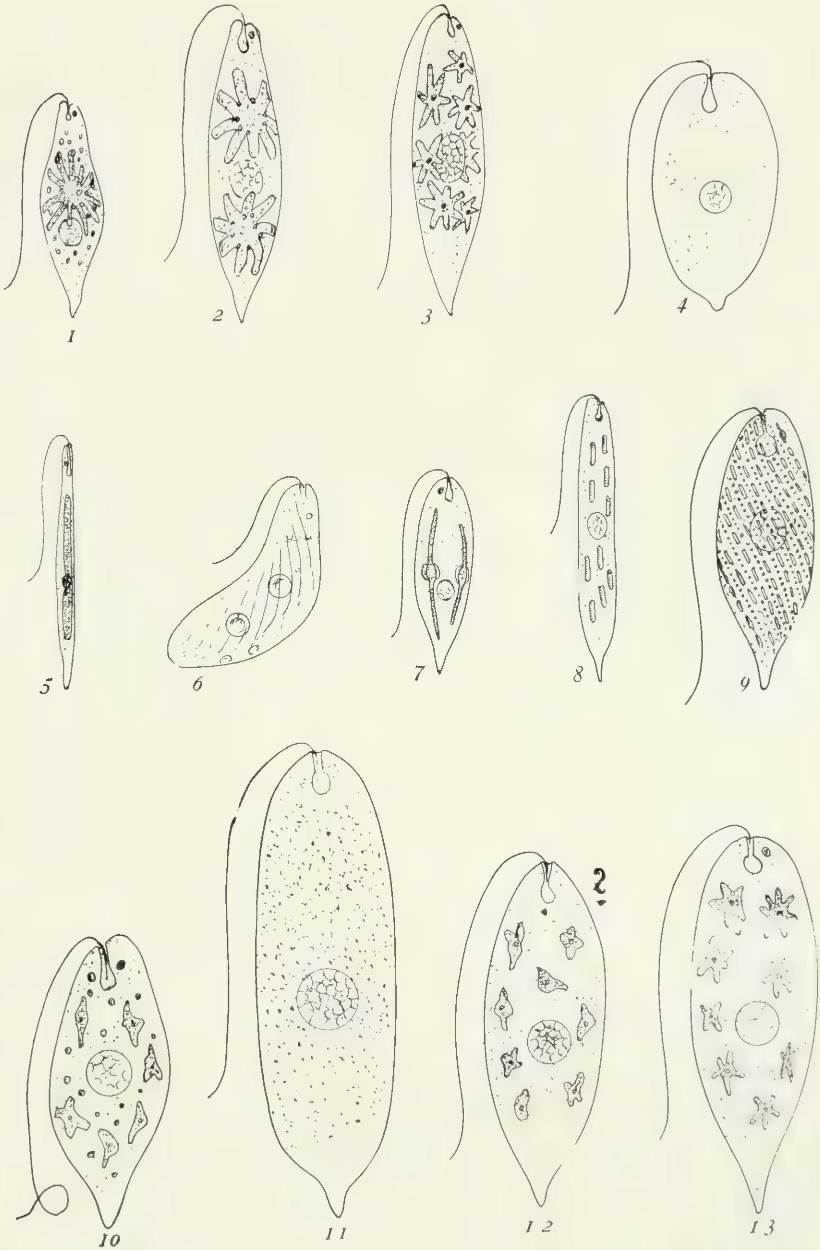
## PLATE XXV

1. *Heteronema mutabile* (Stokes), x 250 (Stokes).
2. *Heteronema klebsii* Senn, x 1000 (Senn).
3. *Heteronema nebulosum* (Dujard.), x 1000 (Lemmermann).
4. *Heteronema globiferum* (Stein), x 1000 (Klebs).
5. *Tropidoscyphus cyclostomus* Senn, x 1000 (Senn).
6. *Tropidoscyphus octocostatus* Stein, x 1000 (Lemmermann).
7. *Notosolenus aposamptus* Stokes, x 1000 (Stokes).
8. *Notosolenus orbicularis* Stokes x 1000 (Stokes).
9. *Notosolenus sinuatus* Stokes, x 1000 (Lemmermann).
10. *Anisonema ovale* Klebs, x 1000 (Lemmermann).
11. *Anisonema emarginatum* Stokes, x 1000 (Stokes).
12. *Anisonema acinus* Dujard., x 1000 (Lemmermann).
13. *Anisonema truncatum* Stein, x 1000 (Stein).
14. *Anisonema pusillum* Stokes, x 1000 (Stokes).

## PLATE XXVI

1. *Ploeotia vitrea* Dujard., x 1000 (Seligo).
2. *Ploeotia marina* n. sp., x 1000 (Calkins).
3. *Metanema variabile* Klebs, x 1000 (Klebs).
4. *Metanema striatum* Klebs, x 1000 (Lemmermann).
5. *Marsupioguster striata* Schewiak, x 1000 (Schewiakoff).
6. *Entosiphon sulcatum* (Dujard.), x 1000 (Lemmermann).
7. *Entosiphon ovatum* Stokes, x 1000 (Stokes).
8. *Entosiphon obliquum* Klebs, x 1000 (Klebs).
9. *Clautriavia mobilis* Mass, x 1000 (Schouteden).
10. *Clautriavia parva* Schout., x 1000 (Schouteden).
11. *Dinema griseolum* Perty, x 1000 (Lemmermann).

OHIO BIOLOGICAL SURVEY—VOL. I, PLATE XII

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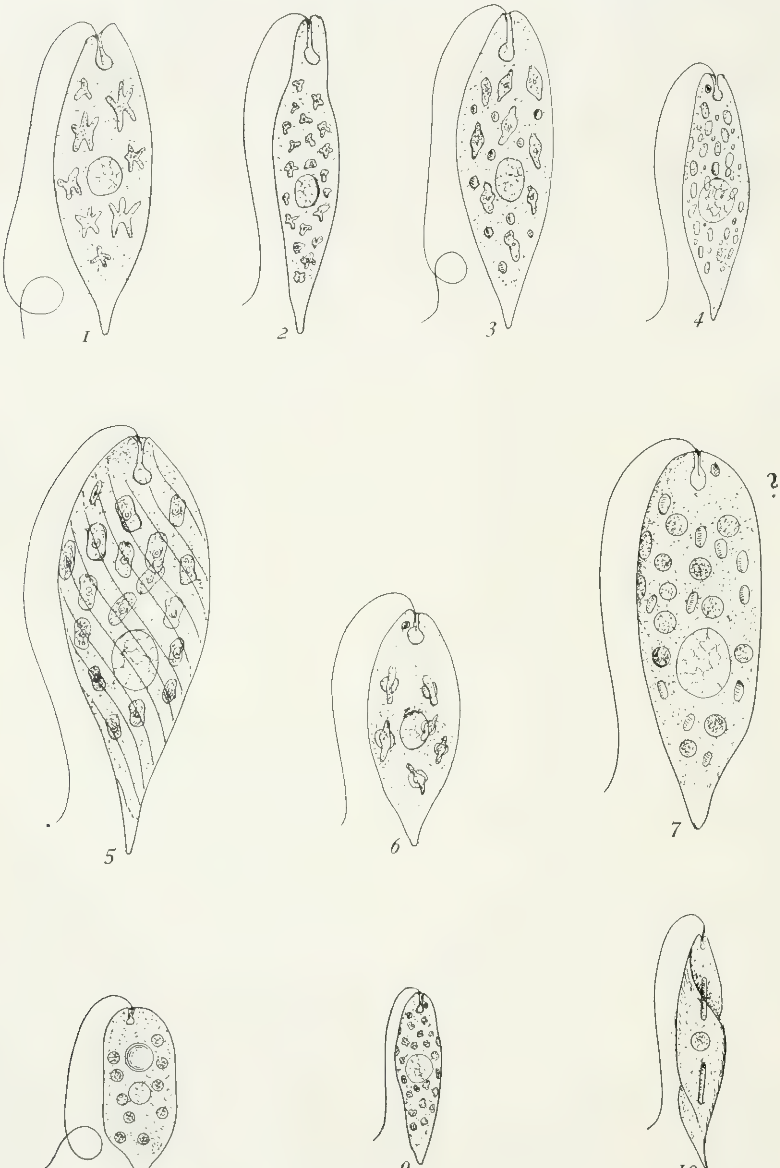
OHIO BIOLOGICAL SURVEY—VOL. I, PLATE XIII

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OHIO BIOLOGICAL SURVEY—VOL. I, PLATE XIV


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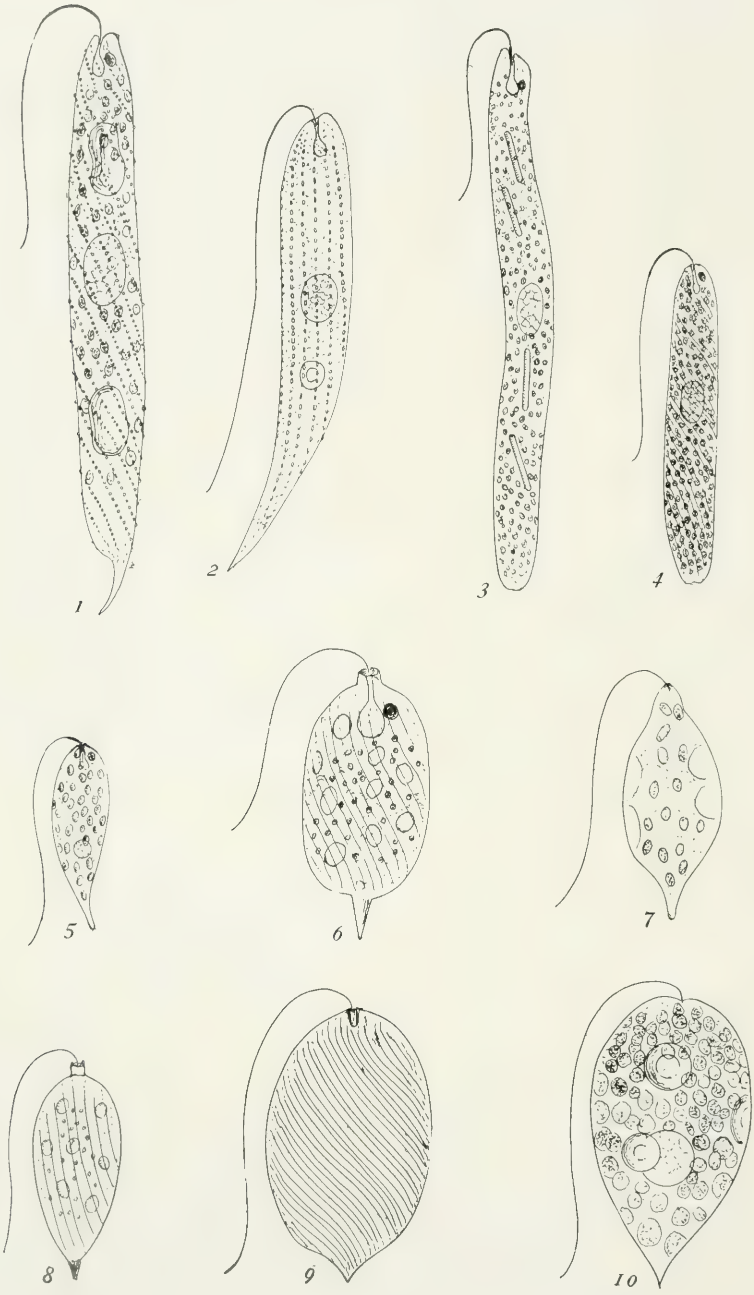
OHIO BIOLOGICAL SURVEY—VOL. I, PLATE XV

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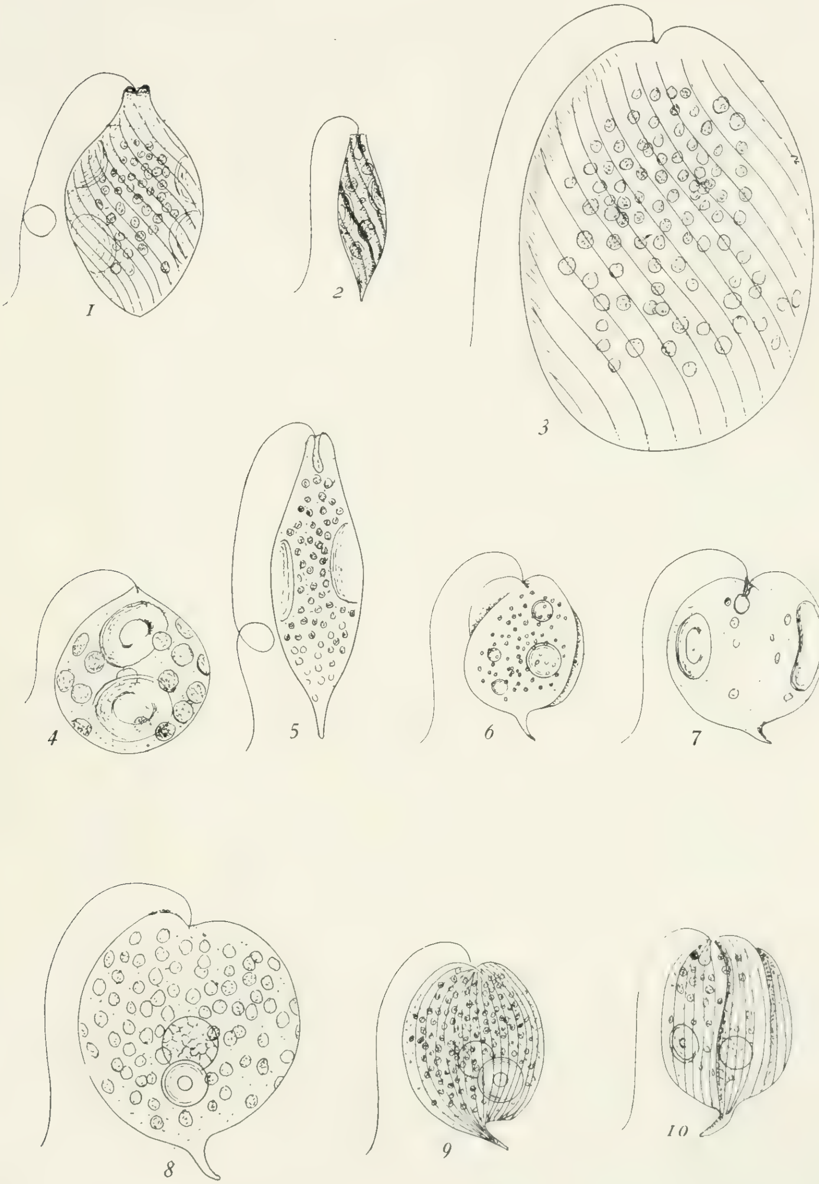


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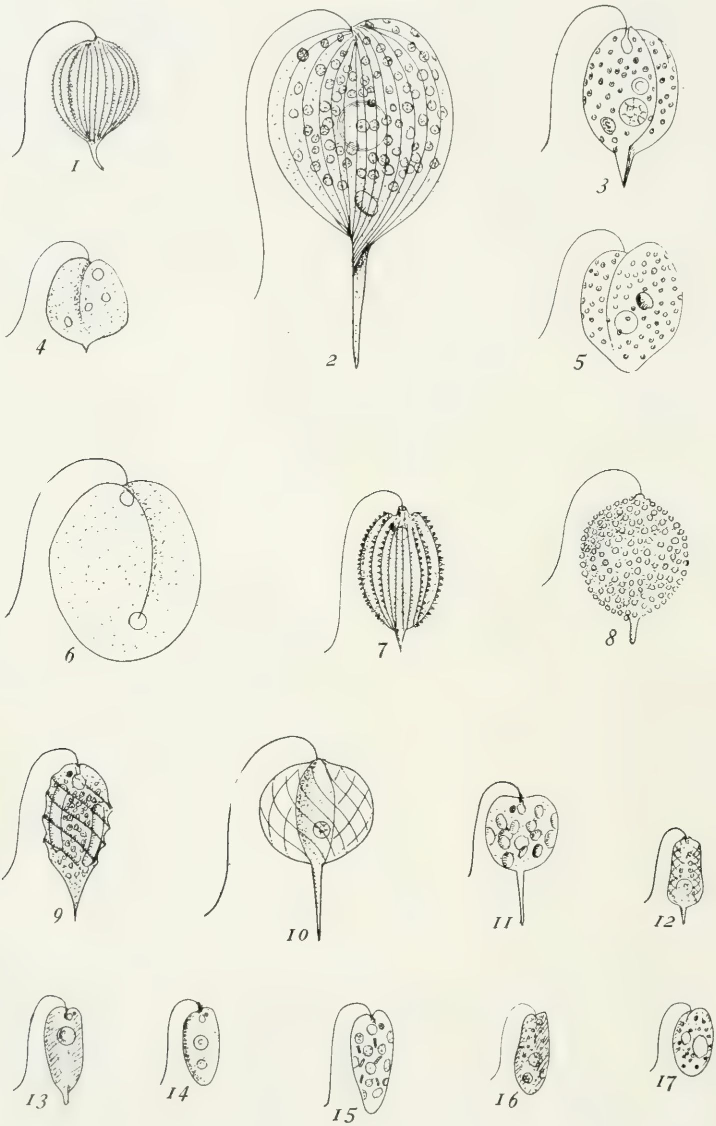
OHIO BIOLOGICAL SURVEY—VOL. I, PLATE XVII

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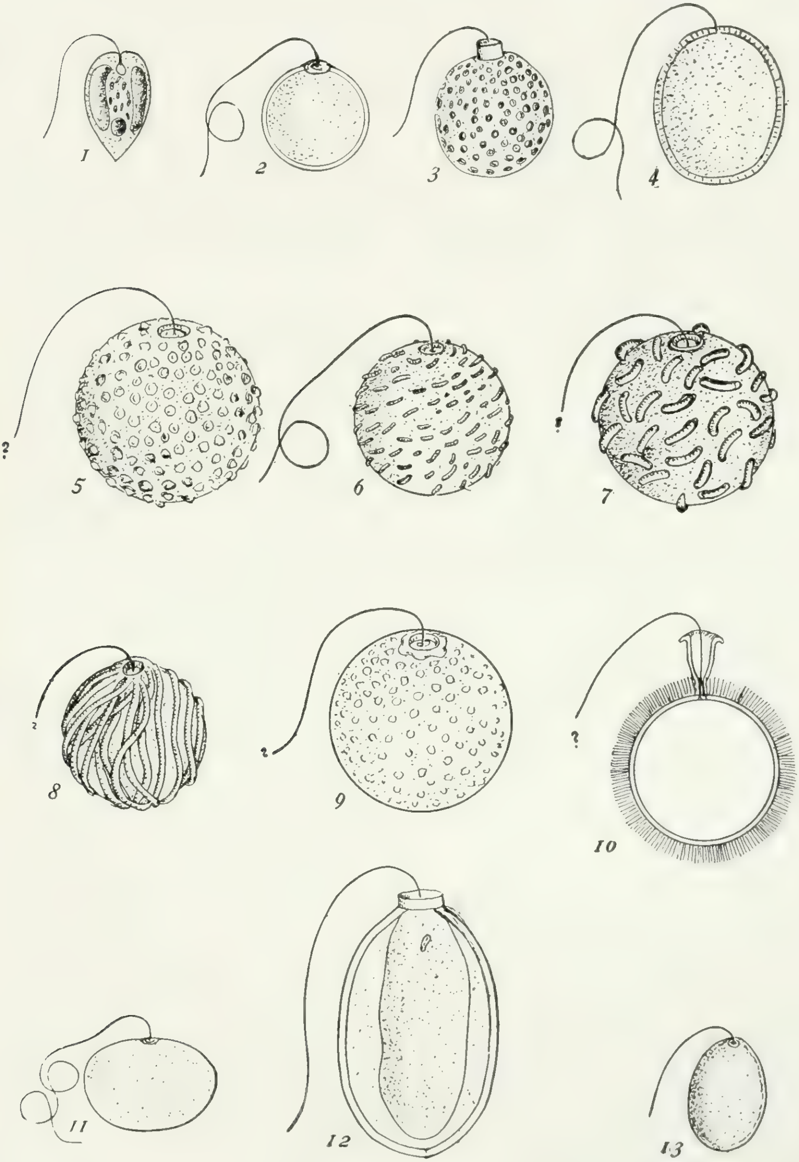


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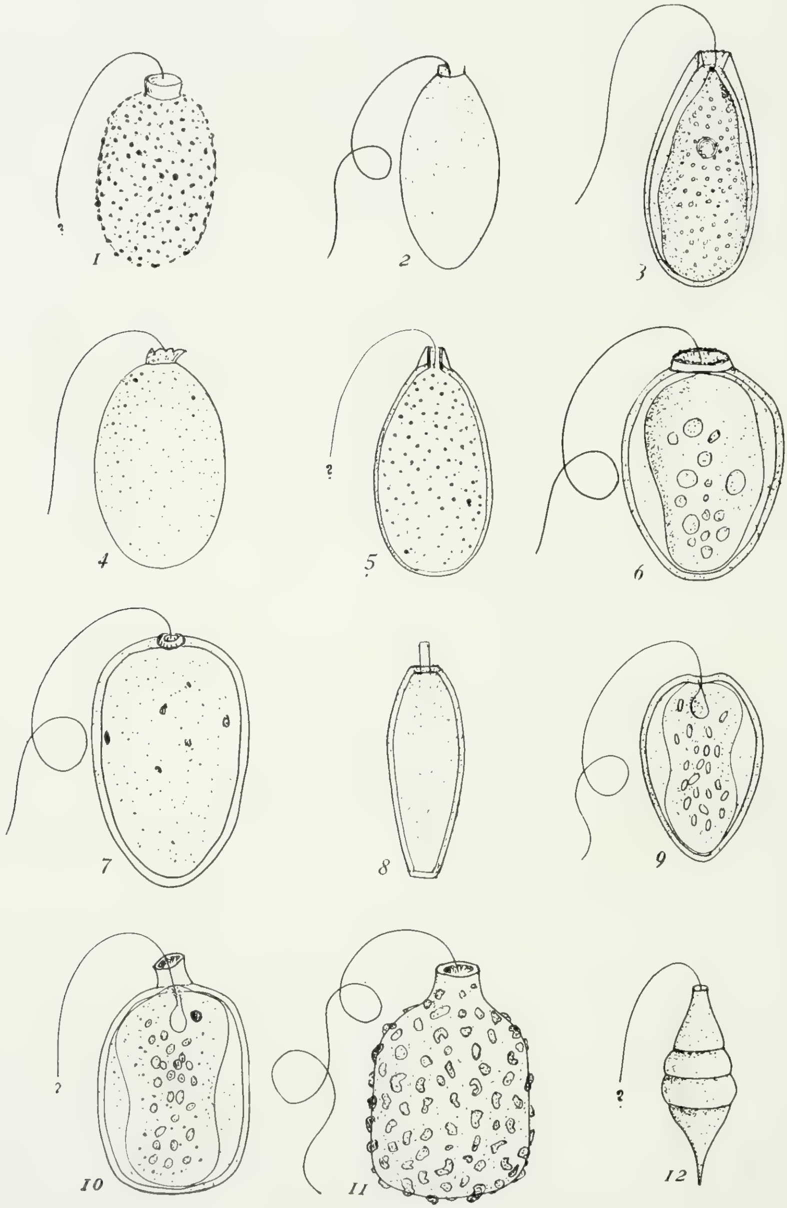


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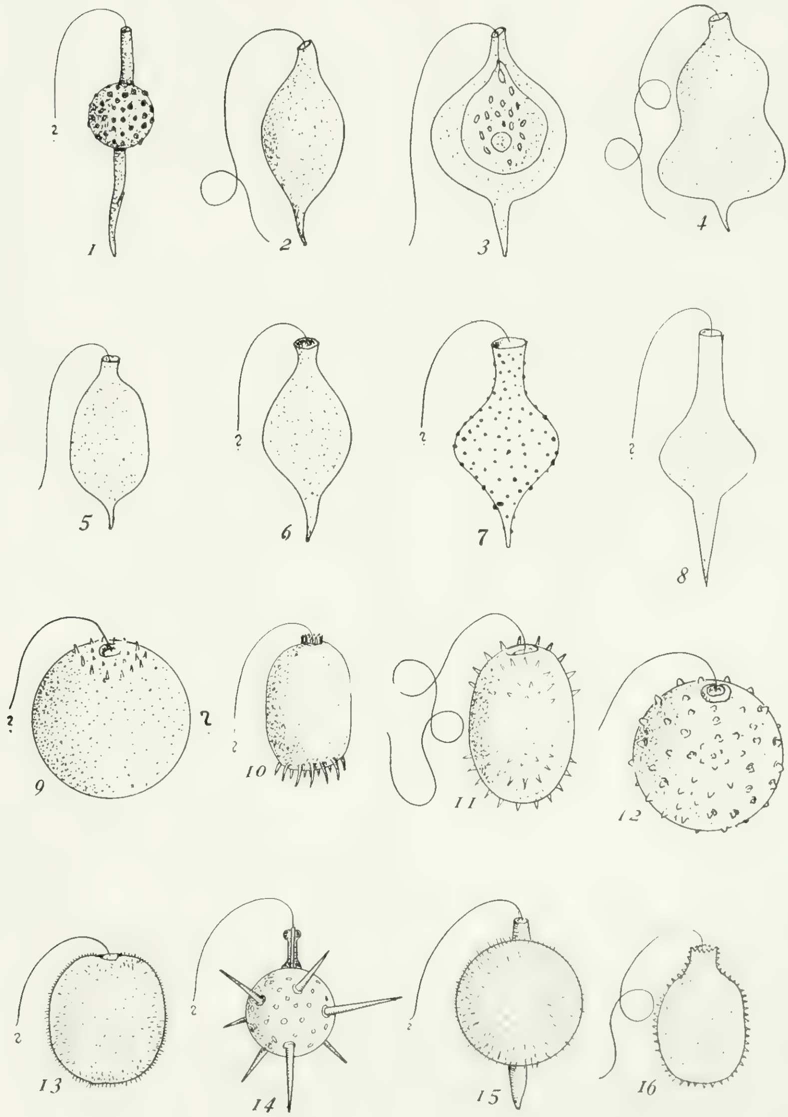


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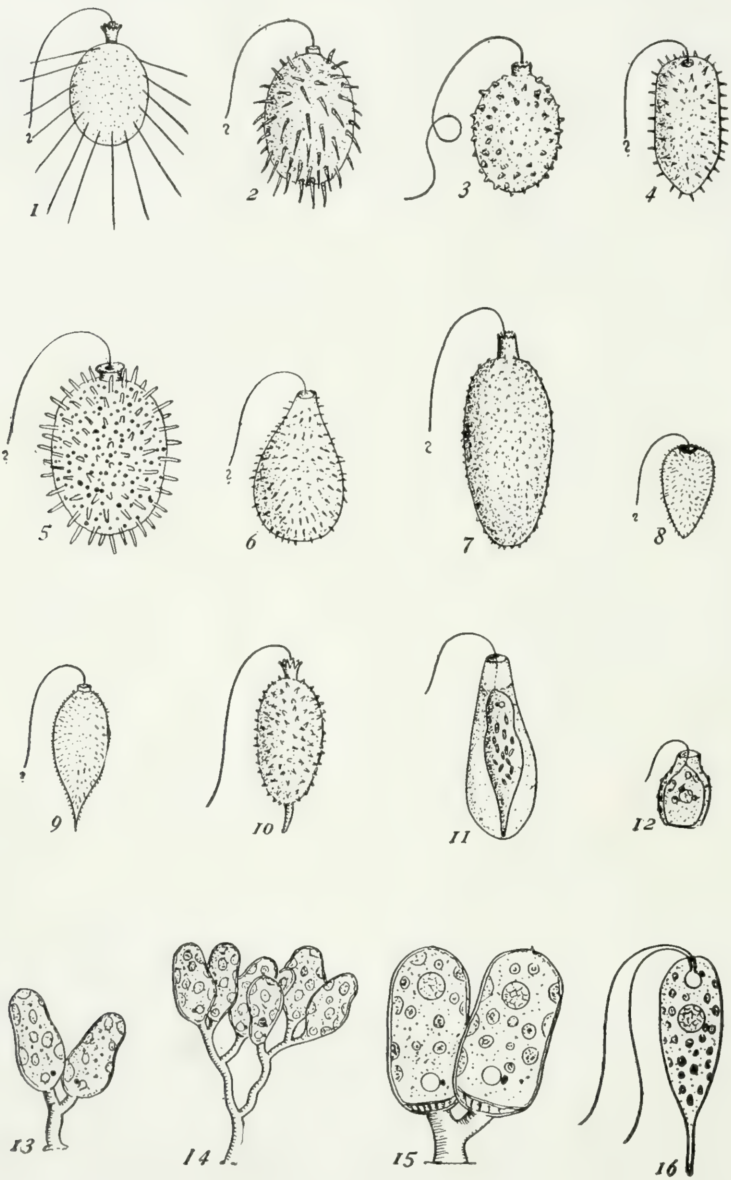


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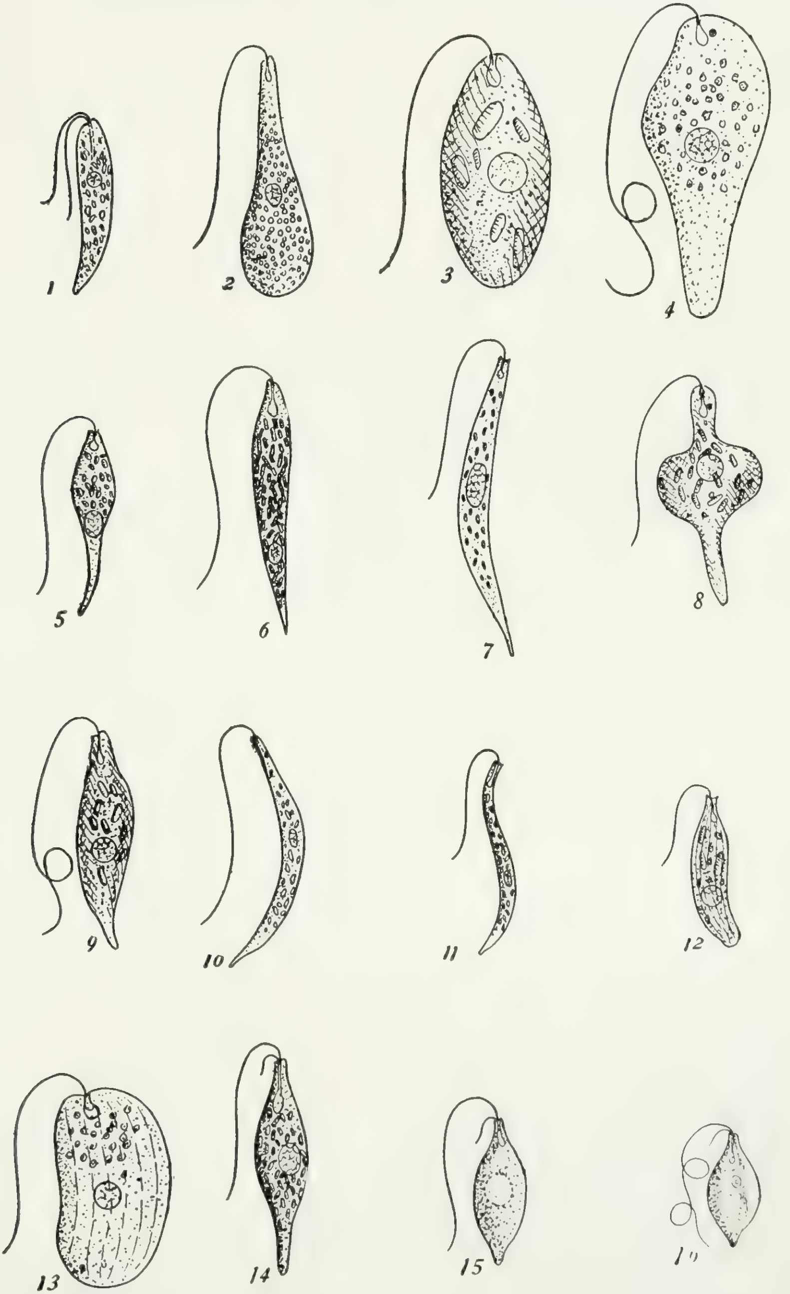

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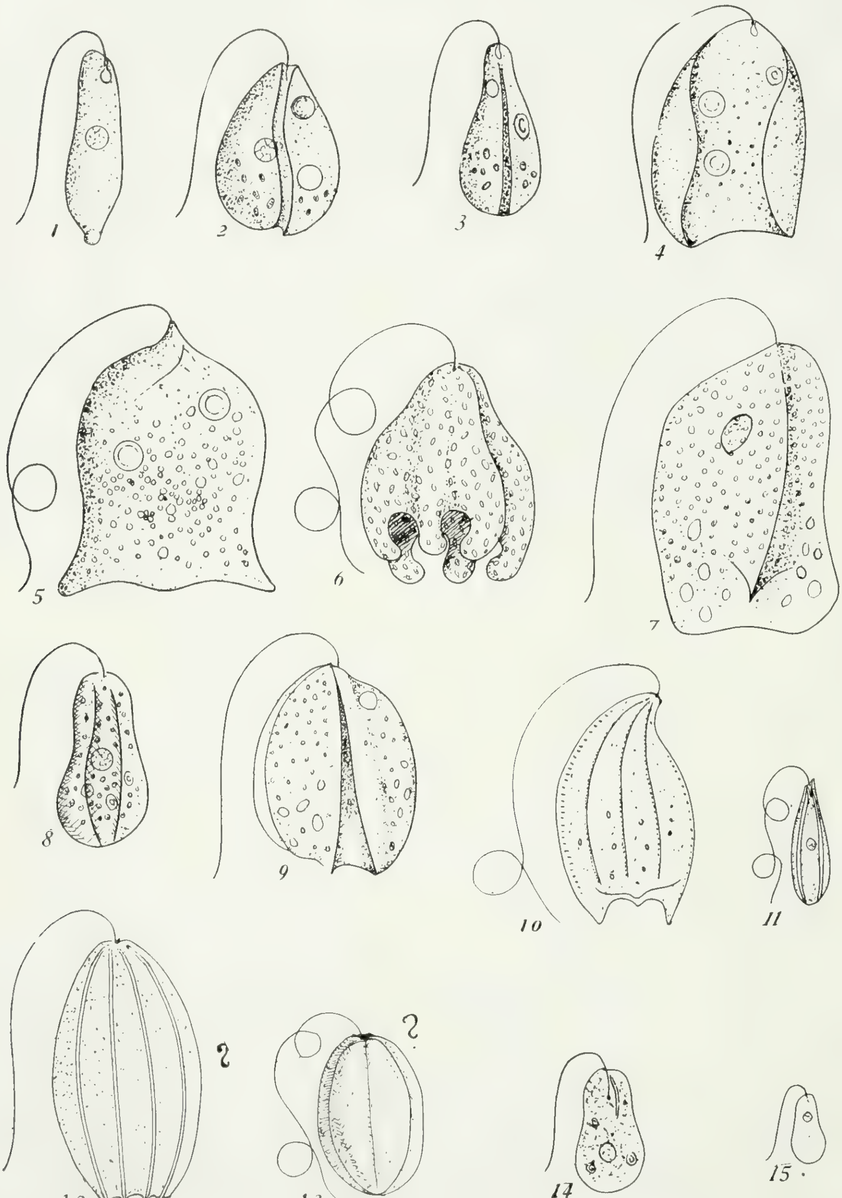


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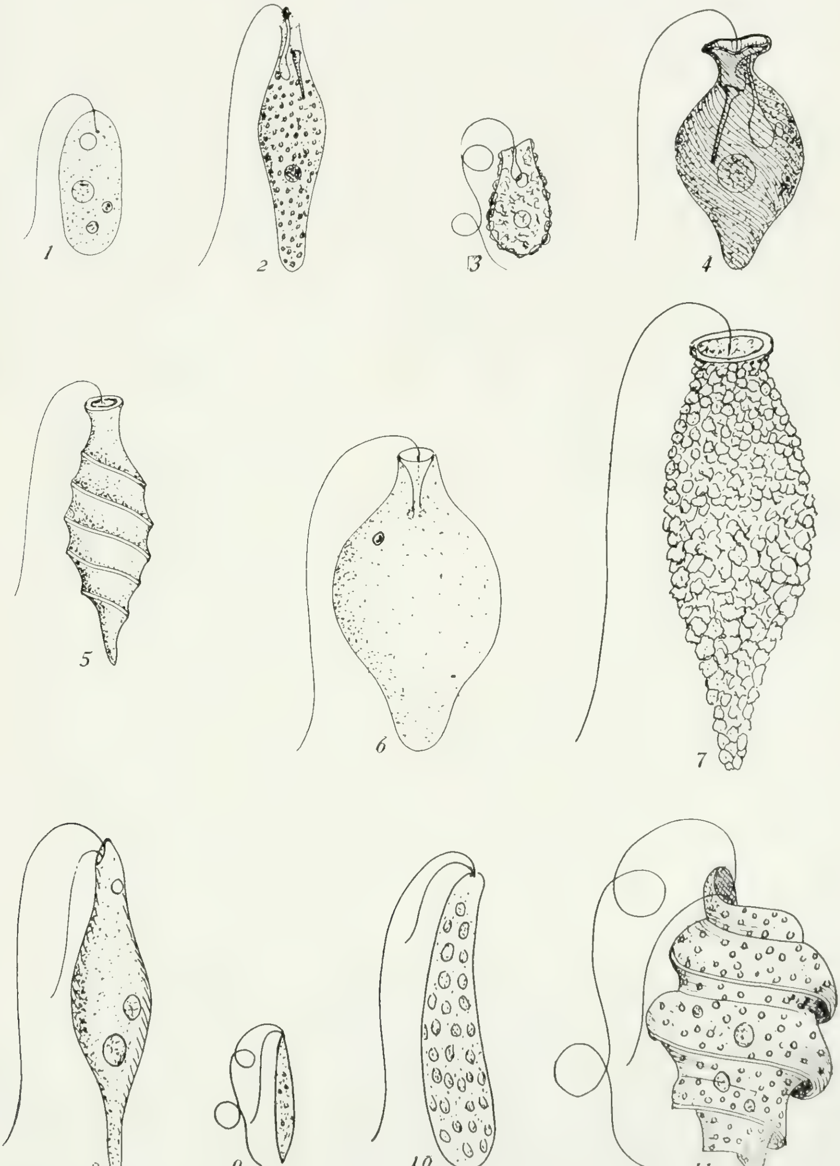


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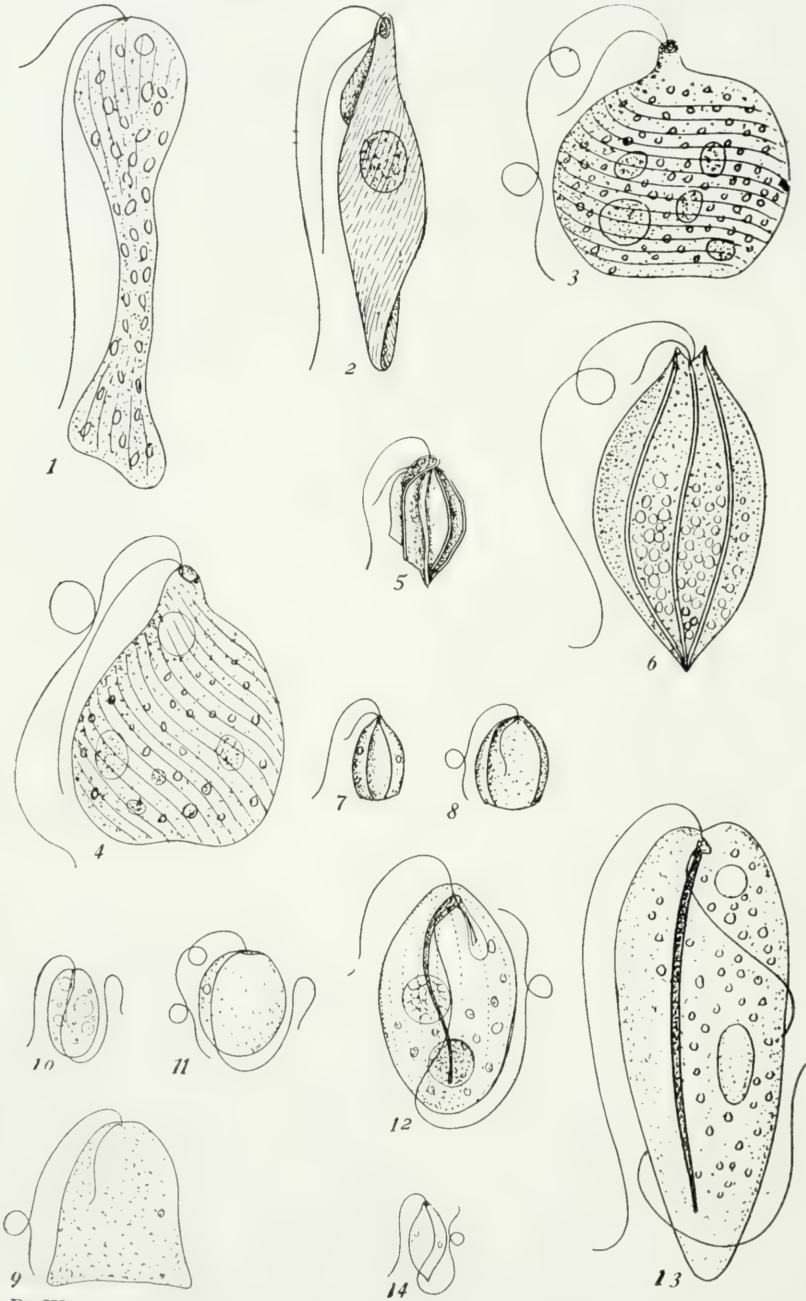


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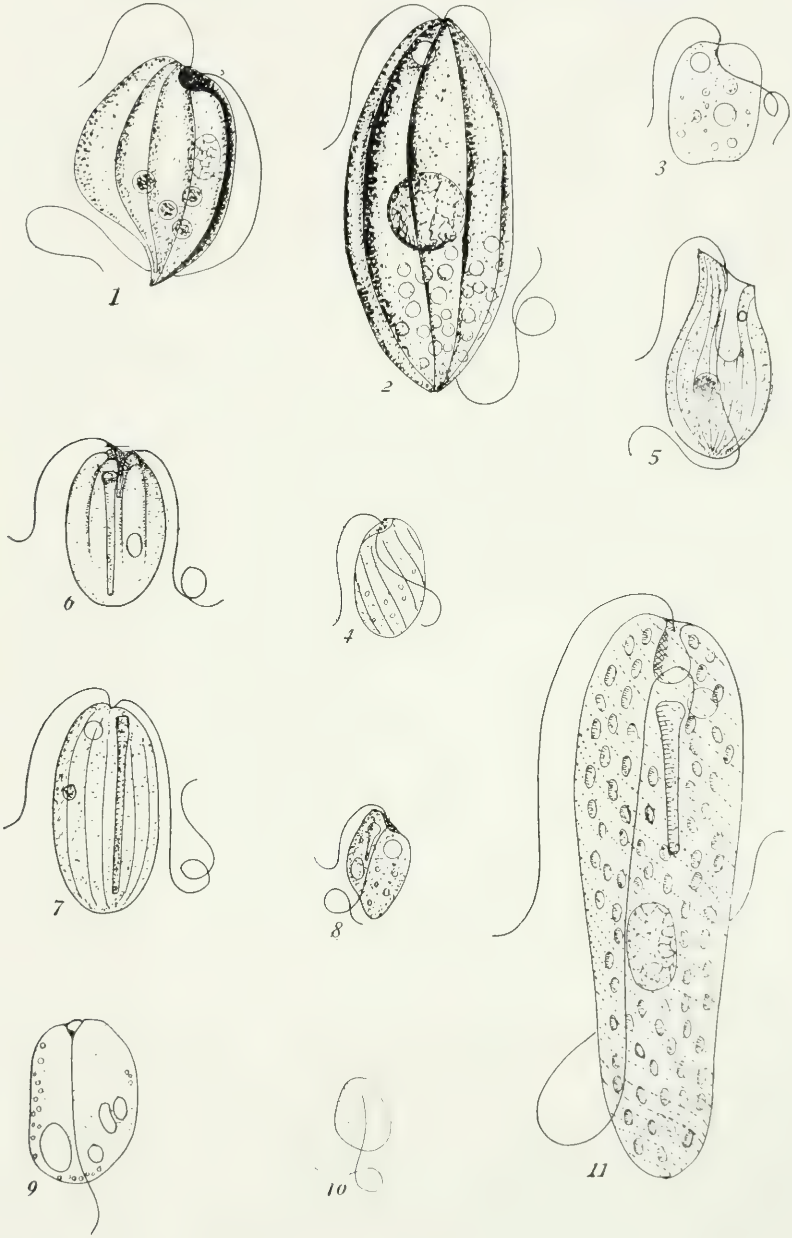


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# Index to Euglenoidina

## ERRATA BULLETIN No. 1

P. 15, l. 29, omit ; after Syritta.
P. 30, l. 1, for pupa read pupae.
P. 39, l. 24, for waternig read watering.
P. 43, l. 2, for Sphaeropuaria read Sphaerophoria.
P. 44, l. 2, for Reaumour read Reaumur.
P. 55, l. 19, for rumieis read rumicis.
P. 55, l. 20, for salicti read saliciti.
P. 62, l. 3, for Molluses read Molluscs.
P. 65, l. 41, for Musea read Musca.
P. 66, l. 7, for lrva read larva.
P. 68, l. 3, for Vloucella read Volucella.
P. 87, l. 34, for vart read var.
P. 87, l. 19, for distincly read distinctly.

## ERRATA BULLETIN No. 2

Page 185—The first 1043. should be omitted altogether.

Page 185—The following was omitted:
1045. Rosa setigera Mx. Prairie Rose.
General, but no specimens from the Northeastern Counties.

Page 211—The following was omitted:
1520. Scrophylaria marylandia L. Maryland Figwort. General.

Page 235—The following was omitted:
2024. Cirsium odoratum (Muhl.) Britt. Fragrant Thistle.
Ashtabula County.

# General Index Volume I

## Index to Vascular Plants 239
## Index to Euglenoidina 447

## Bulletins Ohio Biological Survey

| | | |
|---|---|---|
| I. | Outline of Biological Survey Plan<br>Syrphidae of Ohio by C. L. Metcalf - - - | $ .50 |
| II. | Catalog of Ohio Vascular Plants<br>by John H. Schaffner - - - - - - - - - | .50 |
| III. | Botanical Survey of the Sugar Grove Region<br>by R. F. Griggs - - - - - - - - - - | .50 |
| IV. | The Euglenoidina of Ohio<br>by L. B. Walton - - - - - - - - - - - | .50 |